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National Aeronautics and Space Administration

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

June 23, 1965

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-22273# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.

AN INVESTIGATION INTO THE USE OF TEMPERATURE GRADIENTS AS AN IN-FLIGHT WARNING OF IMPENDING CLEAR-AIR TURBULENCE Environmental Research Papers No. 85

George Mc Lean Feb. 1965 28 p refs

(AFCRL-65-117; AD-613691)

This paper discusses a study that was undertaken to investigate the technique of using in-flight temperature gradients to forecast impending clear-air turbulence (CAT) and some recent studies concerning the relationship between jet stream winds and turbulence. Results of the study indicate that a horizontal temperature gradient observed in flight by direct sensing methods is not a conclusive indicator of impending turbulence. However, an improved in-flight indicator of CAT is needed. If winds obtained from rawinsondes were to be computed at 2000-ft intervals (or less) at the time of the original reduction of data by operational units, the maximum-values of av wind speed (change of wind direction/change of height) could easily be computed, coded, and transmitted as part of the standard upper-air code transmission in the same way as other special parameters. If the value of av wind speed (change of wind direction/change of height) over 2000-ft layers could be computed as described by Kronebach (J. Appl. Meteorology 3:119-125 (1964)) and included in the parameters analyzed by the National Meteorological Center, Suitland, Maryland, the writers feel that a substantial improvement could be made to CAT forecasts using rawinsonde data. TAB

N65-22327# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

MEASUREMENT OF THE INTERFERENCE THAT VARIOUS TRACK PROFILES WOULD PRODUCE ON A BLAST WAVE

S. Dean Lewis and J. Ray Ruetenik Dec. 1964 42 p ref

(Contract AF 04(694)-427)

(ASRL-TR-131-1; AD-612172)

Measurements are made of the interference produced on a step blast wave passing across a model of the Holloman Air Force Base sled track. The effect of building up the berm and filling in the trough of the track is examined using 7 modifications of the present track contour. Author

N65-22368*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL STABILITY CHARACTERISTICS OF SEVERAL PROPOSED PLANETARY ENTRY VEHICLES AT MACH 6.73

Peter T. Bernot Washington, NASA, Apr. 1965 24 p refs

(NASA-TN-D-2785) CFSTI: HC $1.00/MF $0.50

Aerodynamic characteristics of several planetary entry vehicles with different nose-bluntness ratios were obtained over an angle-of-attack range from 0° to 140° at Mach 6.73 and at Reynolds numbers of 0.19×10^6 and 0.25×10^6. At an angle-of-attack of 0°, the flow about these configurations was characterized by large-scale flow separation accompanied by shock-wave fluctuations, notably for the sharp-nose model. As angle of attack was increased about 10°, this separated-flow region on the windward side of the model was swept aside with the result that large increases occurred in normal and axial force and in pitching moment. A high level of positive stability was obtained for all the models at an angle of attack of 0°; for the tests at angles of attack greater than 90°, the models showed no additional stable trim points. Positive stability was maintained for all models near an angle of attack of 0° as center-of-gravity location was varied longitudinally from 20% to 90% of the body length from the nose. Varying the location of the center of gravity along the vertical axis as much as 7.5% of the base diameter resulted in small changes in trim angle of attack. Increasing the nose-bluntness ratio decreased the axial-force coefficient and the stability. Author

N65-22404# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEVICE FOR SIMULATING THE EFFECT OF AERODYNAMIC FORCES ON THE RUDDER AND AILERONS

Ye. L. Kozhevnikov, A. S. Tarasov et al 18 Mar. 1965 7 p Transl. into ENGLISH from Russian Patent no. 154420 (Appl. no. 788276/40-23), 23 Jul. 1962 4 p

(FTD-TT-64-1117/1+2; AD-613162)

A device which simulates the action of aerodynamic forces acting on the rudder and ailerons of inflight aircraft is described. The advantage of this invention over hydraulic power cylinders brought into action by a hydraulic pump unit is that it preserves the perpendicularity of the chord to the plane by changing the created aerodynamic force within broad limits and eliminates the need for surface calibration tests by preserving load stability. An important feature of the design consists of a metallic rod (torsion) securely fastened to a shaped lever sliding on a roller set up on a cantilever which is immovably fastened on a load-bearing surface. The surface of the cantilever contacting with the roller is shaped in such a way that with any deviation of the loaded surface of control between the neutral and extreme positions of contact of the lever and the roller, the axis of revolution and a given point on the chord will

lie in a straight line forming a 90° angle with the chord. The dimensions of torsion are chosen in such a way that the stress which arises on twisting does not go beyond the fatigue strength of the material. This makes it possible to obtain a very stable load with an unlimited number of cycles of loading. Illustrations of the proposed design are presented. S.C.W.

N65-22438# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF FLOW OF A HYPERSONIC GAS STREAM DIRECTED AROUND AXIALLY SYMMETRICAL BODIES

A. M. Antonov 22 Mar. 1965 10 p Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 2, 1964 p 188–193 (FTD-TT-64-1005; AD-613467)

In this report equations of second approximation are investigated of the hypersonic theory of small perturbations. The system of equations, which was obtained by introducing a flow function of second approximation, is reduced to one nonlinear differential equation in partial derivatives. Discussed is also the problem of directing a hypersonic flow around conical bodies. Numerical calculations indicate, the possibility of expanding the zone of application of the theory of small turbulences (perturbations), considering other approximations, to the case of a flow directed around much thicker cones, rather than according to the theory of first approximation. TAB

N65-22486# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

INVESTIGATIONS OF THE FLOW AROUND THE AFTERBODY OF AN AIRCRAFT OR ROCKET

P. Carriere Feb. 1965 38 p refs Transl. into ENGLISH from Tech. Sci. Aeronaut. Spatiales (Paris), v. 1, 1962 p 31–45 (RSIC-369; AD-613334)

The elementary problems involved in the flow around the afterbody of an aircraft or rocket configuration are reviewed. The essential role played by viscosity in the partial flow is pointed out and the fundamental problems of (1) isobaric mixing of the layer between a flow of velocity and a stagnant region; (2) reclosing of the external flow and the mixing layer in the neighborhood of the impact; and (3) separation of the flow, are discussed. Calculations of the thermodynamic and kinematic state of the mixing layer at the instant it comes in contact with the recompression zone that precedes the reclosing were used for the prediction of the rear pressure effects of a variation in Reynolds number, and to predict the variation in the initial curvature of an isobaric jet line caused by variations in the curvature of the rear surface of the body, the tangential pressure gradient over the rear surface, and the normal entropy gradient. Experimental results on studies of a jet in the low-velocity flow around different model configurations are given. G.G.

N65-22605*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AFTERBODY PRESSURES ON BOATTAILED BODIES OF REVOLUTION HAVING TURBULENT BOUNDARY LAYERS AT MACH 6

W. Frank Staylor and Theodore J. Goldberg Washington, NASA, May 1965 47 p refs

(NASA-TN-D-2761) CFSTI: HC $2.00/MF $0.50

An experimental investigation was conducted to determine the effects of boattailing and angle of attack upon base and boattail pressures for bodies of revolution. Afterbodies with boattail angles from 0° to 24° at angles of attack up to 12° were tested at a free-stream Mach number of 5.98 and at a Reynolds number sufficient to cause a turbulent boundary layer to exist ahead of the afterbodies at zero angle of attack. The method presented for predicting boattail pressures gave a reasonable estimate for the present data. From correlation of existing base-pressure data made for boattailed bodies of revolution with turbulent boundary layers, base pressure as a function of boattail angle and cylinder Mach number can be estimated. Experimental data and the present calculations indicate that afterbody pressure drag can be substantially reduced with a relatively short boattail at Mach numbers from 1.5 to 6.0. Author

N65-22606*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MAXIMUM LIFT-DRAG RATIOS OF DELTA-WING-HALF-CONE COMBINATIONS AT A MACH NUMBER OF 20 IN HELIUM

Patrick J. Johnston, Curtis D. Snyder, and Robert D. Witcofski Washington, NASA, May 1965 24 p refs

(NASA-TN-D-2762) CFSTI: HC $1.00/MF $0.50

Maximum lift–drag ratios of a family of delta-wing–half-cone combinations have been determined experimentally at Mach 20 in helium. Reynolds numbers based on overall length varied from 2.75×10^6 to 4.35×10^6. The semiapex angles of the delta wing ranged from 9° to 25°, the apex angles of the half-cone body, from 3° to 9°. Performance measurements were made with the bodies situated both above and beneath the wing. For a given wing-fuselage combination the performance of the flat-bottom configuration was always superior to that of the same configuration inverted. Increasing the half-cone angle invariably resulted in a deterioration in performance of flat-top configurations of fixed wing geometry. For flat-bottom configurations, an increase in half-cone angle was accompanied by a reduction in maximum lift–drag ratios for the more slender wings; however, little or no reduction in performance occurred for the wings with 20° and 25° semiapex angles. For a given cone the most significant gains in performance occurred when the wing semiapex angle just exceeded the half-cone angle. Performance data of this investigation could be correlated on the basis of parameters suggested by linearized supersonic theory although the Mach number was far beyond that for which linear theory is expected to apply. Author

N65-22633*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF INLET CONTROL PARAMETERS FOR AN EXTERNAL–INTERNAL-COMPRESSION INLET FROM MACH 2.1 TO 3.0

Bernhard H. Anderson and David M. Bowditch Washington, NACA, 23 Sep. 1958 19 p refs

(NACA-RM-E58G08) CFSTI: HC $1.00/MF $0.50

(Declassified)

Investigation of the control parameters of an external–internal compression inlet indicates that the cowl-lip shock provides a signal to positiog the spike and to start the inlet over Mach range 2.1 to 3.0. Use of a single fixed probe position to control the spike over the range of conditions resulted in a 3.7-count loss in total-pressure recovery at Mach 3.0 and 0° angle of attack. Three separate shock-sensing-probe positions were required to set the spike for peak recovery from Mach 2.1 to 3.0 and angles of attack from 0° to 6°. When the inlet was unstarted, an erroneous signal was obtained from the normal-shock control through most of the starting cycle that prevented the inlet from starting. Therefore, it was necessary to override the normal-shock control signal and not allow the control to position the terminal shock until the spike was positioned. Author

N65-22660# RAND Corp., Santa Monica, Calif.
ESTIMATE FOR THE PRESSURE ON RAPIDLY ACCELERATING BODIES IN HIGH-SPEED FLIGHT
J. D. Cole Jan. 1965 16 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4153-PR; AD-610067)

Pressure on a slender accelerating airfoil or body of revolution traveling at high speed is estimated by using snowplow theory in a plane transverse to the direction of motion. With this theory a simple explicit expression is obtained for pressure distribution on the body. The theory, valid for rapid accelerations, provides a quantitative estimate of the effect of acceleration on the air forces. The significant parameter measuring the effect is shown to be a Froude number, Fr = (body length)(acceleration)/(speed)^2. The analysis shows that only in extreme cases does acceleration or deceleration exert an important effect on air forces. Author

N65-22856*# National Aeronautics and Space Administration, Washington, D. C.
TO THE THEORY OF ELECTROMAGNETIC WAVE PROPAGATION IN A PIECEWISE-UNIFORM PLANE WAVEGUIDE [K TEORII RASPROSTRANENIYA ELEKTROMAGNITNYKH VOLN V KUSOCHNO-ODNORODNOMVOLNOVODE]
Yu. K. Kalinin Jul. 1962 15 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya, v. 2, no. 1, 1962 p 80–85
(NASA-TT-F-8256) CFSTI: HC $1.00/MF $0.50

The field of a point emitter is examined in a piecewise-uniform waveguide with the help of approximate impedance-type boundary conditions. A formula is obtained for a layout consisting of two extended sections. An estimate is made of the effect of geometrical inhomogeneities. Author

N65-22894# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
DETERMINATION OF SHAPES FOR MINIMUM DRAG FOR A GIVEN LIFT AND BASE AREA IN LINEARIZED SUPERSONIC FLOW
F. van der Walle and P. J. Zandbergen Jul. 1964 25 p refs Revision of NLR-TR-G.10
(NLR-TR-G.28)

A new method to find shapes that attain minimum wave drag under certain constraints is presented. The constraints considered here are given values for the base area and the lift. The configuration is assumed to be embedded in a volume enclosed by two opposing circular Mach cones, one going through the most forward point of the configuration, the other through the rim of the base. The flow field inside this volume is entirely governed by the perturbation velocities on the Mach cone through the base. In fact, the method deals with the procedure to determine the value of these velocities. Once the velocity distribution along the Mach cone is known the flow field and the shape of possible configurations can be found by applying characteristic methods. Two cases are considered; in the first only the value of the base area is prescribed, while in the second the lift is given. As an example the shape and the axis inclinations of a possible ring-wing configuration are calculated. Author

N65-22907 Nord-Aviation, Paris (France). Aerodynamics Dept.
PROPERTIES AND PROBLEMS OF DUCTED FANS [PROPRIETES ET PROBLEMS DE L'HELICE CARENEE]
M. Lazareff *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 223–253 *In* FRENCH; ENGLISH summary (See N65-22900 12-02)

This paper reemphasizes two typical aerodynamic characteristics of ducted fans. The first relates to lift and thrust performance and derives from the possibility (at least theoretically) of exercising effective action on the shroud aerodynamic exit plane area. It becomes possible to consider a compromise between two characteristics which are contradictory in an engine the aerodynamic geometry of which cannot vary very much: high propulsive efficiency at high speeds; and high specific thrust at low or zero forward speed. The last capability makes prolonged hovering flight possible without constant preoccupation of fuel level. The second characteristic concerns value and evolution of the pitching moment during the highly non-axial translation characterizing the transition phase. Attempts were made to develop an evaluation method to take into account appearance of separation phenomena. A partial solution was found by developing a very simple computation model. Experimental results are compared with predictions derived from this model. Author

N65-22963# National Aerospace Lab., Tokyo (Japan).
LINEARIZED AERODYNAMIC THEORY OF ROTOR BLADES. I: LIFTING SURFACE THEORY
Teruo Ichikawa 1964 22 p refs In JAPANESE; ENGLISH summary
(NAL-TR-68)

A linearized lifting surface integral equation is derived as the first step to obtain air-load distributions of rotor blades in forward flight. The equation of the propeller theory already established can be derived as a special case from the above equation. Author

N65-22978# Toronto Univ. (Ontario). Inst. for Aerospace Studies
CHARACTERISTICS OF A RECTANGULAR WING WITH A PERIPHERAL JET IN GROUND EFFECT. PART III
D. Surry Aug. 1964 82 p refs
(Contract AF 33(657)-8451)
(UTIAS-TN-77)

Lift, drag, and pitching moment were measured on a rectangular wing with a peripheral jet in ground effect for three angles of attack, three heights above ground, and for a range of forward speeds necessary for takeoff calculations. Furthermore, nine configurations were tested in this fashion—each with different jet angles and different ratios of L.E. to T.E. jet strengths. Wherever possible, procedures were automated and on-line data reduction was used. Some flow visualization tests were made on specific configurations. The results were used to study an integrated lift and propulsion system for air-cushion takeoff and landing. These calculations showed little advantage to be gained from using variable jet strengths and angles during takeoff at constant height when compared to fixed configuration results. The latter used angle of attack, or diversion of thrust from the cushion to direct forward thrust as means for keeping the height constant. A simple takeoff procedure in which the height is allowed to increase naturally, led to slightly poorer results, but all the takeoff procedures studied provided short-field performance. Author

N65-23041*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AERODYNAMIC PRINCIPLES FOR THE DESIGN OF JET-ENGINE INDUCTION SYSTEMS
Wallace F. Davis and Richard Scherrer Washington, NACA, 27 Feb. 1956 188 p refs
(NACA-RM-A55F16) CFSTI: HC $5.00/MF $1.25
(Declassified)

A summary of past research on air-induction systems is presented. The relationships between induction system, airframe, and engine are discussed; and the established design principles regarding drag, pressure recovery, flow uniformity, flow steadiness, and induction-system-airframe interference summarized. References and bibliography are given. Author

N65-23076*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF A 0.067-SCALE MODEL OF THE X-15 AIRPLANE (CONFIGURATION 2) AT MACH NUMBERS OF 2.29, 2.98, 3.96, AND 4.65
Arthur E. Franklin and H. Norman Silvers Washington, NASA, May 1959 247 p ref
(NASA MEMO-4-27-59L) CFSTI: HC $6.00/MF $2.25
(Declassified)

An investigation was made in the Langley Unitary Plan wind tunnel to determine the drag, static longitudinal and lateral stability characteristics, and control-surface bending- and torsion-moment characteristics of a 0.067-scale model of the X-15 airplane (configuration 2). The investigation was made at Mach 2.29, 2.98, 3.96, and 4.65 at a Reynolds number of about 2.6×10^6. In addition, the effect of Reynolds number was shown at Mach 2.98 and 4.65 by results obtained at Reynolds numbers of about 1.0×10^6 and 4.2×10^6. Author

N65-23168*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF ARBITRARY QUASI-ORTHOGONALS FOR CALCULATING FLOW DISTRIBUTION ON A BLADE-TO-BLADE SURFACE IN A TURBOMACHINE
Theodore Katsanis Washington, NASA, May 1965 36 p refs
(NASA-TN-D-2809) CFSTI: HC $2.00/MF $0.50

A method, suitable for computer programing, of analyzing flow on a blade-to-blade surface of a turbomachine is presented. The method is based on an equation for the velocity gradient along an arbitrary quasi-orthogonal between blades and is similar to a method using quasi-orthogonals in a meridional plane. With this method, a streamline analysis can be made for any blade-to-blade stream surface. This surface, if desired, may be assumed to be a surface of revolution generated by a meridional streamline obtained from a meridional streamline analysis. On this stream surface a two-dimensional solution for the velocity and pressure distributions is obtained. With several such blade-to-blade solutions, the velocity distribution throughout the rotor passage can be calculated. Simplifying assumptions for upstream and downstream conditions are made for the purpose of readily obtaining a reasonable approximation near the inlet and outlet. The method was applied to a radial inflow turbine with splitter vanes. These results are given as a numerical example, and the blade surface velocities obtained are compared with those obtained by a simple linear velocity method. The comparison shows a large discrepancy between the linear velocity method and the method near the outlet, but most of the blade is in reasonable agreement. The Fortran computer program is included. Author

N65-23284*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF AN UNDERSLUNG NORMAL-WEDGE INLET AT FREE-STREAM MACH NUMBERS FROM 1.50 TO 1.99
Donald J. Vargo and Maynard I. Weinstein Washington, NACA, 19 Mar. 1957 17 p refs
(NACA-RM-E56F27) CFSTI: HC $1.00/MF $0.50
(Declassified)

The performance of a normal-wedge inlet with a straight and a sweptback splitter plate was investigated and is compared with a previously tested scoop-type inlet. Both the normal-wedge and the scoop-type inlets were tested on a 1/5-scale model of a supersonic missile forebody in an 8- by 6-foot supersonic wind tunnel. In general, no significant differences could be detected between the performances of the normal-wedge configurations with straight and sweptback splitter plates. At the higher Mach numbers both of the normal-wedge inlets had higher pressure recoveries and greater stability, but higher drag than the scoop inlet. On a thrust-minus-drag basis the higher recovery made the normal-wedge inlets superior at a free-stream Mach number of 1.99, while the equal or better recoveries of the scoop inlet made it better at free-stream Mach numbers of 1.80 and 1.50. Author

N65-23315# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GASDYNAMICS OF ENGINES
A. I. Borisenko 12 Oct. 1964 887 p refs Transl. into ENGLISH of the book "Gazovaya Dinamika Dvigateley" Moscow, Ges. Nauchno-Tekhn. Izd. Oborongiz, 1962 p 3-793
(FTD-TT-63-852/1+2; AD-609452)

The basic problems of the gasdynamics of aircraft engines, particularly gas turbines are reviewed. The statements are preceded by a derivation and analysis of the equations of the mechanics of continuous media. One-dimensional and linearized plane flows are considered in detail. A theory is given of the isolated profile and the profile skeleton. Fundamental information on boundary layers is outlined; the theory of a wing of finite span is presented in brief. The inlet arrangements of a jet, the nozzles, are considered in detail. The physics of cavitation and spraying of liquids, the fundamentals of the mechanics of highly rarefied gases, and the elements of magnetogasdynamics are discussed. Author

N65-23320# Royal Aircraft Establishment, Farnborough (England).
A STUDY OF THE LONGITUDINAL RESPONSE OF AIRCRAFT TO TURBULENT AIR
J. K. Zbrozek London, Min. of Supply, Jan. 1955 32 p refs
(RAE-AERO-2530).

A method of calculating the aircraft dynamic behavior in turbulent air is presented. The dynamic behavior of aircraft in continuous turbulence is examined theoretically, investigating the influence of the following parameters: static margin (changing C.G. position), damping in pitch, lift slope, wing loading, and aircraft size. The theory outlined provides the information required in gunnery and bombing problems and should be useful in the studies of automatic stabilization and gun- and bomb-sight design. Some results regarding gust loads in continuous turbulence are also obtained, which may have application in studies of the fatigue life of aircraft structures. Author

N65-23331*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF AN ISENTROPIC, ALL-INTERNAL-CONTRACTION, AXISYMMETRIC INLET DESIGNED FOR MACH 2.50
David N. Bowditch and Bernhard H. Anderson Washington, NACA, 15 Sep. 1958 28 p refs
(NACA-RM-E58E16) CFSTI: HC $2.00/MF $0.50
(Declassified)

An experimental investigation of an internal-contraction, axially symmetric inlet with isentropic compression surfaces on both the cowl and centerbody was conducted over a range of Mach numbers from 2.0 to 2.7 at angles of attack from 0° to 6°. The study was to determine the optimum bleed system, together with a method of controlling the inlet. At Mach 2.5, bleeding of about 0.3% by means of perforations ahead of the throat allowed a 3% larger running contraction ratio than could be obtained with no supersonic bleed and permitted the centerbody to retract to the design position. Best subsonic bleed system consisted of flush slots located opposite each other on the cowl and centerbody just downstream of the

throat. By bleeding 13% with this system, a peak recovery of 0.91 was obtained at Mach 2.5. Cowl static pressures ahead of these slots appeared satisfactory for sensing the normal-shock position. However, the centerbody position would have to be scheduled with Mach number, angle of attack, and Reynolds number since no pressure signal was found that would permit prediction of critical internal contraction. Author

N65-23335*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF MULTIPLE JET-EXIT INSTALLATIONS
John M. Swihart and William J. Nelson Washington, NACA, 7 Jul. 1958 14 p refs
(NACA-RM-L58E01) CFSTI: HC $1.00/MF $0.50
(Declassified)

This paper presents the results of recent exploratory investigations of the performance of clustered jet-exit installations at Mach 0.60 to 3.05. Data presented were obtained with tunnel-wall-mounted models with cold-air-jet exhaust. The results indicate that large base-pressure drag coefficients may be encountered in the transonic and low supersonic speed range and that the best configuration investigated was boattailed between the nacelles, had a cylindrical nacelle afterbody, and a divergent nozzle with a design pressure ratio of 15. It was also indicated that afterbody terminal fairings or base bleed might be used to reduce the performance losses of overexpanded nozzles. If the terminal fairings or base bleed were applied to fixed ejector geometry, an important saving in weight and complexity would result. Author

N65-23336*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE TRANSONIC AND SUPERSONIC DIVERGENCE CHARACTERISTICS OF A DELTA-PLAN-FORM ALL-MOVABLE CONTROL
A. Gerald Rainey, Perry W. Hanson, and Dennis J. Martin Washington, NACA, 4 Aug. 1958 29 p refs
(NACA-RM-L58E07) CFSTI: HC $2.00/MF $0.50
(Declassified)

Static aeroelastic divergence characteristics of a delta-planform model of canard control surface of a proposed air-to-ground missile have been studied both analytically and experimentally in Mach range 0.6 to 3.0. Experiments indicated that divergence occurred at a nearly constant value of dynamic pressure at Mach numbers up to 1.2. At higher Mach numbers somewhat higher values of dynamic pressure were required to produce divergence. The analysis and the experiment indicate that the camber stiffness of the control surface and the stiffness of the control actuator are both important in divergence of surfaces of this type. Author

N65-23338# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Aerodynamics Section
NORMAL FORCE COEFFICIENTS FOR HYPERSONIC DELTA WINGS
B. W. Hannah Dec. 1964 21 p refs
(ADN-01-07-64.1)

A simplified method for predicting the normal force coefficient of hypersonic delta lifting surfaces was developed. The method is applicable over an angle-of-attack range from 10° to 40°, with a sweep angle from 60° to 82°, and a Mach number of 5 or above. Calculated values of normal force coefficient are compared with available experimental data; the predicted values fall within ±3% of the experimental values as compared to 20% for Newtonian estimates and 30% for wedge predictions. Author

N65-23345*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC DESIGN OF AXIAL-FLOW COMPRESSORS
Irving A. Johnsen and Robert O. Bullock, ed. Washington, NASA, 1965 524 p refs Revised Supersedes NACA-RM-E56B03; NACA-RM-E56B03A; NACA-RM-E56B03B (NASA-SP-36) GPO: $3.00; CFSTI: MF $2.50

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N65-23346* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OBJECTIVES AND SCOPE
Irving A. Johnsen and Robert O. Bullock *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 1–8 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

The general objectives and scope of the overall report on the aerodynamic design of axial-flow compressors are presented. The basic problem of compressor design is outlined, and the approach generally taken to accomplish its solution is pointed out. Author

N65-23347* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPRESSOR DESIGN REQUIREMENTS
Robert O. Bullock and Ernst I. Prasse *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 9–51 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Requirements of axial-flow compressors for aircraft gas-turbine engines and reasons for these requirements are reviewed. Attention is directed to overall requirements of the engines themselves; the desired properties of compressors are examined. Cycle analyses of the turbojet and turboprop engines are presented to illustrate the effects of compressor pressure ratio and efficiency on engine performance. The significance of high flow capacity in compressors is indicated. The compromises in compressor design dictated by aerodynamic design limitations in the compressor itself as well as aerodynamic and structural design limitations in other components are investigated. The pertinent off-design problems resulting from the necessity of matching the compressor with the inlet and with the turbine over a range of flight conditions are enumerated, and some available methods of coping with these problems are discussed. From these studies, the basic objectives of a compressor design system are evolved. Author

N65-23348* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPRESSOR DESIGN SYSTEM
Rober O. Bullock and Irving A. Johnsen *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 53–100 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

A general description is presented for the compressor design system adopted for this report on the aerodynamic design of axial-flow compressors. The basic thermodynamic equations are given, and simplifications commonly introduced to permit the solution of these equations are summarized. Representative experimental data are presented to justify these simplifications. Thus, a valid simplified flow model is provided. The individual elements of the design system and the basic calculations required to execute the aerodynamic design of a compressor are summarized. The improvements in knowledge required to make compressor design a truer science and promising directions of future research are indicated. Author

N65-23349* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POTENTIAL FLOW IN TWO-DIMENSIONAL CASCADES
William H. Roudebush *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 101–149 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

The flow through axial-flow compressors, at least near the mean radius, is often sufficiently close to a mathematically two-dimensional flow that valuable results can be achieved by using two-dimensional theory. An extensive review is presented of literature concerning plane potential flow in cascades. No method of determining the flow is preferable under all conditions. The nature of the individual problem and the computing equipment available dictate the method to be used. Some techniques for solving the two basic problems, design and analysis, are evaluated; and several methods that have been used satisfactorily are presented in considerable detail. Author

N65-23350* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VISCOUS FLOW IN TWO-DIMENSIONAL CASCADES
William H. Roudebush and Seymour Lieblein *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 151–181 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Boundary-layer behavior on two-dimensional compressor blade sections is described, based on a review of available theory and experiment. The material is divided into two main sections, one presenting a qualitative discussion of boundary-layer behavior, and the other treating the quantitative aspects of boundary-layer theory as applied to cascade blades. In the qualitative analysis, the general characteristics of laminar and turbulent boundary layers are reviewed. Instability and transition and their influence on boundary-layer behavior are discussed. An attempt is made to construct a qualitative picture of blade losses determined over a wide range of Reynolds number, surface pressure gradient, and free-stream turbulence. The section on quantitative boundary-layer theory discusses some approximate methods for computing the growth and separation of laminar and turbulent boundary layers. The loss in total pressure and defect in circulation resulting from blade boundary-layer growth are also considered. Author

N65-23351* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL FLOW IN TWO-DIMENSIONAL CASCADES
Seymour Lieblein *In its* Aerodyn. Deisgn of Axial-Flow Compressors 1965 p 183–226 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Available experimental two-dimensional-cascade data for conventional compressor blade sections are correlated. The two-dimensional cascade and some of the principal aerodynamic factors involved in its operation are described. The data are analyzed by examining the variation of cascade performance at a reference incidence angle in the region of minimum loss. Variations of reference incidence angle, total-pressure loss, and deviation angle with cascade geometry, inlet Mach number, and Reynolds number are investigated. From the analysis and the correlations of the available data, rules and relations are evolved for the prediction of the magnitude of the reference total-pressure loss and the reference deviation and incidence angles for conventional blade profiles. These relations are developed in simplified forms readily applicable to compressor design procedures. Author

N65-23352* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BLADE-ELEMENT FLOW IN ANNULAR CASCADES
William H. Robbins, Robert J. Jackson, and Seymour Lieblein *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 227–254 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

A blade-element analysis is made of annular-cascade data obtained primarily from single-stage-compressor test installations. The parameters that describe blade-element flow are discussed with reference to the many variables affecting them. The blade-element data are correlated over a fairly wide range of inlet Mach number and cascade geometry. Two blade shapes are considered in detail. Compressor data at three radial positions near the tip, mean, and hub are correlated at minimum-loss incidence angle. Curves of loss, incidence angle, and deviation angle are presented for rotor and stator blade elements. These correlation curves are presented so that they are directly related to the low-speed two-dimensional-cascade results. As far as possible, physical explanations of the flow phenomena are presented. In addition, a calculation procedure is given to illustrate how the correlation curves could be utilized in compressor design. Author

N65-23353* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN VELOCITY DISTRIBUTION IN MERIDIONAL PLANE
Charles C. Giamati, Jr., and Harold B. Finger *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 255–278 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

A discussion is presented of the general flow equations and methods to be used in determining the radial distributions

of flow in the meridional (hub-to-tip) plane of an axial-flow compressor when the required performance is specified. The problem of determining the radial distributions of flow is simplified by considering conditions at axial stations between blade rows where nonviscous, axisymmetric flow equations are applied. The analysis presumes the availability of blade-element data on deviation angle and on stagnation-pressure loss for all design techniques. Methods for considering the effects of wall boundary layers on required annulus area and mass-averaged stage performance are presented. A sample stage design calculation is given. Author

N65-23354* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHART PROCEDURES FOR DESIGN VELOCITY DISTRIBUTION
Arthur A. Medeiros and Betty Jane Hood *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 279–295 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

A series of charts for the solution of the flow equations in the design of axial-flow compressors is developed. The equations, presented in chart form, are radial equilibrium (in a simplified form), continuity of flow, energy addition, efficiency, vector relations, and diffusion factor. Because the charts are based on general flow equations, they can be used in the design of any axial-flow compressor. An example of the use of the charts in the design of a stage consisting of a rotor and stator blade row is presented. Comparison of the pertinent design values obtained by the chart procedure with analytically calculated values indicates that good accuracy can be attained by careful use of the charts. Author

N65-23355* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTION OF OFF-DESIGN PERFORMANCE OF MULTISTAGE COMPRESSORS
William H. Robbins and James F. Dugan, Jr. *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 297–310 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Three techniques are presented for estimating compressor off-design performance. The first, based on blade-element theory, is useful for obtaining only a small part of the compressor map over which all blade elements in the compressor operate unstalled. The second method, which involves individual stage performance curves and a stage-by-stage calculation, is useful for estimating the performance of a compressor for which reliable stage performance curves are available. The third method, based on overall performance data of existing compressors, may be used to estimate the complete performance map of a new compressor if the compressor design conditions are specified. Author

N65-23356* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPRESSOR STALL AND BLADE VIBRATION
Robert W. Graham and Eleanor Costilow Guentert *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 311–330 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Extent of the useful operating range of the multistage axial-flow compressor is influenced by its stalling characteristics. There is a minimum flow point for each speed where the compressor will either surge or stall, depending upon the geometry of the compressor receiver. If surge does not occur, the efficiency will be so poor in the stalled condition that the compressor will limit the useful operation of a turbojet engine. These surge or stall points define the familiar surge or stall-limit line. Stall of the front and rear stages occurs at part-speed and overspeed operation, respectively. Serious blade vibrations may occur for either of these conditions as a results of stall. Compressor stall may be manifested as rotating stall, individual stall of each blade, or stall flutter, the first of which seems most prevalent. Several theories of rotating stall in single-stage compressors appear, none of which can predict propagation rates with any reliability. However, they are useful in evaluating significance of parameters pertinent to the stall-propagation mechanism and thus in planning experimental research programs. Prediction of rotating-stall data for multistage compressors is even more complicated, because of interaction effects among the stages. Author

N65-23357* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPRESSOR SURGE
Merle C. Huppert *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 331–340 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Experimental data indicate that there are two principal types of surge in compressors: (1) surge due to an abrupt stall, and (2) surge due to progressive stall. Surge due to abrupt stall is generally violent and audible, whereas that occurring with progressive stall is generally mild and inaudible. The violent surge obtained in jet engines during engine acceleration is identified as surge due to abrupt stall. Author

N65-23358* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPRESSOR OPERATION WITH ONE OR MORE BLADE ROWS STALLED
William A. Benser *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 341–364 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Analysis of the part-speed operating problems of high-pressure-ratio multistage axial-flow compressors is made by a simplified stage-stacking study. Problems considered are poor low-speed efficiency, multiple-valued performance characteristics at intermediate speeds, and poor intermediate-speed compressor surge or stall-limit characteristics. Analysis indicates that all these problems can be attributed to discontinuities in the performance characteristics of the front stages. Such discontinuities can be due to the type of stage stall or to a deterioration of stage performance resulting from stall of adjacent stages. Effects of compromises of stage matching to favor part-speed operation are considered; such compromises would severely reduce the complete-compressor-stall margin. The low-speed stage stall problem is transferred from the inlet stages to the middle stages, which are more susceptible to abrupt-stall characteristics. Inlet stages having continuous performance characteristics at their stall points are desirable with respect to part-speed compressor performance. However, these characteristics must be obtained when the stages are operating in the flow environment of the multistage compressor. Alleviation of part-speed operational problems may also be obtained by improvement in either stage flow range or stage-loading margin. In addition to these stage-matching studies, a general discussion of variable-geometry features is included. Author

N65-23359* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THREE-DIMENSIONAL COMPRESSOR FLOW THEORY AND REAL FLOW EFFECTS
Howard Z. Herzig and Arthur G. Hansen *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 365–384 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Discrepancies observed between actual flow in an axial-flow compressor and theoretical simplified design flows increase in magnitude and diversity with the trend toward more compact

compressors. The research into design procedures to reduce these discrepancies is reviewed and discussed. The improved design procedures are arbitrarily classified into two categories. One includes investigations that successively extend the design procedures from the simplified-radial-equilibrium axially symmetric designs to the complex complete three-dimensional design. The second includes individual studies of more restricted problems. Author

N65-23360* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SECONDARY FLOWS AND THREE-DIMENSIONAL BOUNDARY-LAYER EFFECTS
Arthur G. Hansen and Howard Z. Herzig *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 385–411 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

A survey of experimental and theoretical research on secondary flows and three-dimensional boundary-layer flows as applicable to compressor flow phenomena is presented. The results of experimental research are used to construct a simple model of secondary flow in compressor blade rows. The limitations of the application of present research on secondary flows to flow in a multistage compressor and indications of ways this research might be applied to current design considerations are also presented. Author

N65-23361* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF DESIGN AND MEASUREMENT ERRORS ON COMPRESSOR PERFORMANCE
Robert J. Jackson and Peggy L. Yohner *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 413–468 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Effects of design errors on compressor performance parameters and of measurement errors on calculated values of performance parameters are analyzed. Formulas and charts are presented from which changes in blade-element performance and calculated parameters due to the design and measurement errors can be determined. The use of the design-error charts during the design calculations and in the analysis and interpretation of data is discussed. The charts can be used to evaluate the sensitivity of a given velocity diagram to design errors and to determine whether iterations of design calculations are warranted. The measurement-error charts can be employed for estimation of uncertainty intervals in calculated performance and can also be of assistance in evaluation of data and in planning of instrumentation for research and development. Author

N65-23362* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPRESSOR AND TURBINE MATCHING
James F. Dugan, Jr. *In its* Aerodyn. Design of Axial-Flow Compressors 1965 p 469–496 (See N65-23345 12-01) GPO: $3.00; CFSTI: MF $2.50

Methods are presented for relating the compressor to other components of the simple turbojet, the afterburning turbojet, the turboprop with coupled power turbine, and the turboprop with free-wheeling power turbine engines. Method of superposing component matching maps to obtain one- and two-spool gas-generator performance is discussed, as are simplified methods for obtaining gas-generator performance. Simplification results from assuming constant turbine-inlet equivalent weight flow and an approximate relation for turbine efficiency. Compressor operation can be found from the gas-generator performance alone for a range of flight conditions when the mode of engine operation is specified by assigning values of mechanical speed and turbine-inlet temperature. Procedures are also discussed for (1) combining the gas generator with other components of gas-turbine engines; (2) locating constant-exhaust-nozzle-area equilibrium operating line on the compressor performance map of a one-spool nonafterburning turbojet engine operated at static sea-level conditions; (3) matching components of a one-spool simple turbojet engine during transient operation for a specified flight condition, a specified transient path on the compressor map, and a fixed exhaust-nozzle area; (4) finding compressor paths during a transient for a nonafterburning two-spool turbojet for which the exhaust nozzle area and inner-turbine-inlet temperature are constant; and (5) calculating time to accelerate to a higher engine speed for both one- and two-spool turbojet engines. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-22220# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aeronautical Systems Div.
CATEGORY II ARCTIC EVALUATION OF THE YCH-47A HELICOPTER
Ronald E. Stanford and D. Bruce Griggs Dec. 1964 389 p (ASD-TDR-64-86; AD-611581)

The YCH-47A Helicopter was tested under arctic conditions at Eielson AFB, Alaska during the period 10 December 1963 to 6 February 1964. Testing consisted of flights both at moderately low (+10° F to −20° F) and very low temperatures (−20° F to −30° F) as well as ground operation down to −40° F. Along with conducting an overall evaluation of the helicopter's effectiveness in a cold environment, a number of improvements to correct earlier low temperature deficiencies were tested and found adequate. This report contains a description of the test procedures, selected instrumentation data, a discussion of the deficiencies uncovered and recommendations for their correction. Problems encountered in the Arctic were instability arising from SAS (Stability Augmentation System) operation, delamination of rotor blade fiberglass skins, and extreme difficulty in ground handling on hard packed snow, ice, or similar slippery surfaces. In order for the helicopter to be suitable for low temperature operation, new or modified rotor blades with assured structural integrity must be incorporated along with other improvements recommended in this report. Author

N65-22303 Army Electronics Labs., Fort Monmouth, N. J.
NEW HIGH-ALTITUDE FAST-RISING BALLOON
Moses Sharenow *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 361–374 refs (See N65-22275 12-34)

The theory, design, and development are presented of a novel type of balloon for a fast-rising, high-altitude meteorological balloon. The design consists of an inner high-altitude balloon and an outer streamline balloon. The assembly is so designed that it will ascend rapidly to approximately 50 000 ft. At this altitude the streamline balloon bursts and falls away from the inner balloon. The inner balloon now, by virtue of its increased free lift, proceeds to accelerate at the upper level of flight, providing a faster ascent rate throughout most of the flight than that which the individual component balloons

are capable of attaining. Various techniques for successfully separating the streamline balloon from the spherical balloon during flight are discussed, as well as some of the problems encountered in inflating the balloon on the ground. Author

N65-22345# Stanford Research Inst., Menlo Park, Calif.
CORRELATION BETWEEN CLEAR-AIR TURBULENCE AND ELECTRIC FIELDS Scientific Report No. 1
J. E. Nanevicz, E. F. Vance, and S. Serebreny Feb 1965 33 p refs
(Contract AF 19(628)-3308)
(AFCRL-65-112; AD-613035)

The results of a cooperative effort by Stanford Research Institute, United Air Lines, and Air Force Systems Command to determine the correlation between regions of clear-air turbulence and aircraft electrical activity are described. Corona discharges from precipitation static dischargers on DC-8 aircraft were monitored and correlated with clear-air turbulence encounters. A significant correlation was found to exist between clear-air turbulence encounters and periods of electrical discharges. It is suggested that these electrical discharges may be caused by electric fields in the region of clear-air turbulence, particulate matter in the region that charges the aircraft, or a combination of both. Author

N65-22364*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF THE INFLUENCE OF AIRCRAFT TIRE-TREAD WEAR ON WET-RUNWAY BRAKING
Trafford J. W. Leland and Glenn R. Taylor Washington, NASA, Apr. 1965 23 p refs
(NASA-TN-D-2770) CFSTI: HC $1.00/MF $0.50

Wet-runway braking tests were conducted at the landing-loads track in which smooth and dimple-tread tires were used to represent completely worn tires. Five circumferential grooves were then cut into the tires to depths representing varying degrees of tread wear. Two types of wear were simulated: uniform wear with all grooves cut to the same depth, and nonuniform wear with the center groove wearing completely smooth while significant depths remain in the outer grooves. For comparative purposes, tests were made on dry and damp concrete surfaces and through water depths of 1 inch. On the wet runway, a gradual degradation in braking effectiveness was experienced up to about the 80% worn tire-tread condition, where the wet-runway friction coefficients dropped markedly. The completely worn tire was observed to develop, at the higher speeds, only about one-half the braking effectiveness of a new tire. Author

N65-22523# Edo Corp., College Point, N. Y.
FLIGHT TESTS OF THE JRF-5 EQUIPPED WITH A GRUNBERG HYDROFOIL SYSTEM Final Engineering Report
Jan. 1965 71 p refs
(Contract NOw-63-0300-c)
(Rept.-6653; AD-460707)

The results demonstrate that a supercavitating section hydrofoil is a basic requirement for the successful application of hydrofoil principles to water-based aircraft. The prototype aircraft required modification of the bow skid design, as the configuration corresponding to the towing tank model could not take off because of development of detrimental spray characteristics not present in the model tests. The various bow skid modifications leading to the final design are described. The behavior characteristics and instrumentation data obtained are discussed. The hydrodynamic response of the aircraft, while foiling through waves, indicates the desirability of investigating the effect of size reduction on both the bow skids and hydrofoil. Author

N65-22612# Advisory Group for Aeronautical Research and Development, Paris (France).
AIRCRAFT MANOEUVRE LOADS
W. A. P. Fisher Jul. 1964 69 p refs
(AGARD-480)

This report supplies basic data for an aircraft loads manual for AGARD. Recording accelerometer data from a number of U.S. and British reports were extracted and summarized. A method is developed for extracting the information on maneuver loads required for design purposes. Data on the frequency of normal accelerations for a wide range of military aircraft and missions are tabulated. Tables showing the corresponding mean, standard deviation, and skewness of the distribution of forward speeds associated with the high normal accelerations are presented. Tables are given showing the actual or predicted maximum speeds of numerous British service aircraft for standardized flying times. A summary is given of analyses of the percentage time spent at various speeds by some selected U.S. aircraft (fighter/bombers, two trainers, one bomber, two transports). Author

N65-22683# Little (Arthur D.) Inc., Cambridge, Mass.
ELECTRICAL BEHAVIOR OF AN AIRPLANE IN A THUNDERSTORM
Bernard Vonnegut Feb. 1965 65 p refs
(Contract FA-64-WA-5151)
(FAA-ADS-36)

Airplanes in flight can develop electrical charges on their surface as the result of a variety of processes but the maximum amount of charge that they can carry is limited by point discharge and is negligibly small compared to the charge transferred by a lightning discharge. Although the amounts of net or induced charge on the airplane are small compared to the amount of charge in the thundercloud, these charges can locally cause an appreciable intensification of the electric field of a thunderstorm. While some lightning discharges to airplanes may be attributable to chance alone, there are reasons to believe that the electric charges on the airplane may either attract or initiate lightning discharge. It is not feasible to produce a significant reduction in the probability of an airplane receiving a lightning discharge by any technique for controlling the charge on the airplane. The most promising solution to the hazards posed by lightning is to design airplanes so that they are capable of receiving discharges without damage. Author

N65-22822# Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
METALLURGICAL EVALUATION OF A FAILED AIRCRAFT STAINLESS STEEL EXHAUST SYSTEM COMPONENTS
T. H. Mc Cunn Jan. 1965 66 p refs
(Contract FA-NAF-176)
(FAA-ADS-28)

A total of 12 samples from small aircraft exhaust systems were investigated metallurgically. Three of the samples, referred to as baseline, were from new, unused systems. These were examined metallographically for general microstructural characteristics and chemically analyzed. The other samples were from systems which had failed while in flight operation. These samples were examined metallographically and analyzed chemically to determine the cause(s) of failure. The investigation was supplemented by visual examination and in some instances identification of the constituents of the oxidation or corrosion products by X-ray means. The samples were representative of a number of designs and different types of failures which were encountered. Practically all the materials were AISI Type 321, a titanium-stabilized austenitic stainless steel. Examination of the baseline samples showed microstructures of the base metal, weld and weld heat-affected zone

to be normal. Four samples failed because of excessive oxidation or high temperature corrosion. Four other samples from mufflers of similar design and one sample of a different design showed fatigue cracks. The failures were attributed to excessive vibrational and/or thermal stresses in the presence of abrupt changes in section size and likely locations for crack initiation. Author

N65-22861# McDonnell Aircraft Corp., St. Louis, Mo.
STOL-V/STOL CITY CENTER TRANSPORT AIRCRAFT STUDY
1 Oct. 1964 174 p refs
(Contract FA-64-WA-5012)
(FAA-ADS-26; B122)

A comparison is made of design, performance, and direct operating costs of two V/STOL, and two STOL transport aircraft to be operational in 1975. The V/STOL aircraft in the study are a tilt wing-propeller type and a turbofan lift engine type. The STOL aircraft are the propeller deflected slipstream type and a STOL version of the tilt wing-propeller type. Propulsion systems are projected to a technological level that could be employed in an aircraft design initiated in 1970. Microminiaturization of electronic equipment is incorporated to the degree considered acceptable operationally and financially by 1975. All aircraft are designed for a stage length of 500 statute miles, and performance and direct operating costs are shown for stage lengths of 50 to 750 miles and for aircraft gross weights of 40 000 to 100 000 pounds. Typical three views are shown for one size of each of the four aircraft. The results of the parametric sizing study of each aircraft are shown as group weight breakdowns, mission performance, dimensional tabulations and curves, noise level profiles, and takeoff and landing characteristics. Author

N65-22900# Advisory Group for Aeronautical Research and Development, Paris (France).
V/STOL AIRCRAFT, PART I
Sep. 1964 479 p refs Proc. of a meeting held at NATO Headquarters, Paris, 1-5 Sep. 1964
(AGARDograph-89)

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15. V/TOL CONTROL SYSTEMS, ESPECIALLY CONTROL BY THRUST MODULATION X. Hafer p 449-473 refs (See N65-22915 12-02)

N65-22901 Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).
VIEWPOINT OF SNECMA ON PROPELLERS FOR SHORT OR VERTICAL TAKEOFF AIRCRAFT [POINT DE VUE DE LA SNECMA SUR LES PROPULSEURS POUR AVIONS A DECOLLAGE COURT OU VERTICAL]
S. Boudigues *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 1-10 *In* FRENCH; ENGLISH summary (See N65-22900 12-02)

It was found that the dual-flow engine with upstream or downstream fan weighed about 10% more than the single-flow engine for any bypass ratio. In the case of the single-flow engine a compression ratio of five, with a single turbine, gives the minimum specific weight. From the viewpoint of mass-flow rate, 30 to 40 kg/sec provide variations slow enough to obtain a rather flat curve around the minimum specific weight. A specific weight of 0.06 may thus be achieved. By increasing the temperature in front of the turbine, this figure may be reduced but at the cost of an increase in the specific fuel consumption. A compressor with a 186 kg/sec mass-flow rate per square meter of frontal area was tested. This type of transonic compressor with high stage loading would seem to be most suitable for lift engines. Whether or not a power bleed or jet deflection is used during takeoff, the dual-flow engine shows a decisive advantage in consumption for subsonic flight. When equipped with reheat, continuously controlled according to flight Mach number, it may compete with highly compressed single-flow turbojets for supersonic flight. Author

N65-22902 General Electric Co., Cincinnati, Ohio. Flight Propulsion Div.
PROPULSION PRINCIPLES IN V/STOL AIRCRAFT
Arthur P. Adamson and Peter G. Kappus *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 11-59 (See N65-22900 12-02)

Technological requirements for development of vertical takeoff and landing (VTOL) aircraft are discussed in detail. The problem of determining optimum VTOL propulsion systems for particular missions can be reduced to choosing from a few basic components: lift/cruise engines, direct lift fans, and vectoring devices. Lift/cruise engines can be developed around a single basic gas generator and can have wide applicability. The current state-of-the-art in propulsion technology is sufficient for undertaking VTOL projects. J.M.D.

N65-22903 General Motors Corp., Indianapolis, Ind. Allison Div.
DIRECT LIFT ENGINES FOR TACTICAL VTOL AIRCRAFT
D. H. Jacobson *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 61-110 (See N65-22900 12-02)

The two parameters that most directly affect the lift engine selection are installed engine weight and fuel consumption for preselected hovering time periods. The turbojet appears to offer the best solution for the extremely short hovering requirements and the turbofan lift engine appears optimum at longer hovering times. The large improvements in thrust/weight ratio for lift engines has enabled the designer of VTOL aircraft to minimize the mismatch in thrust that exists between takeoff and cruise flight conditions. The system tradeoffs narrow down to the weight of an engine sized for cruise plus the additional weight of lift engines, compared to a main propulsion engine sized for takeoff plus the weight and volume of excessive amounts of fuel. The results of a detailed analysis evaluating several lift systems installed in both VTOL fighter and transport aircraft indicate that engines must be uncompromisingly designed for cruise. The thrust needed above this amount, to account for the difference in takeoff weight and aircraft control, should then be provided by separate lift engines. The final selection of the lift system will be modulated by other factors such as frontal area, volume and control requirements. Author

N65-22904 Westland Aircraft, Ltd., Yeovil (England).
THE DOMAIN OF THE CONVERTIBLE ROTOR
R. Hafner *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 111–146 refs (See N65-22900 12-02)

This paper discusses in general terms the whole VTOL family of aircraft and includes noise considerations and the effect of disc loading. The need for balancing the design of the VTOL aircraft in the two modes of flight is also demonstrated. Specifically, feasibility studies of the convertible rotor configuration are described from the economic and technical aspects, with emphasis on the propulsion side and on fail-safe techniques in rotor systems. The convertible rotor is shown to be the best solution when economy at high subsonic cruise speed is required. Author

N65-22905 Ling-Temco-Vought, Inc., Dallas, Tex. LTV Vought Aeronautics Div.
SURVEY OF SIGNIFICANT TECHNICAL PROBLEMS UNIQUE TO V/STOL ENCOUNTERED IN THE DEVELOPMENT OF THE XC-142A
Lyman C. Josephs *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 147–183 refs (See N65-22900 12-02)

The XC-142A is a tilt-wing, deflected slipstream configuration, powered by four GE T-64 engines driving 15 1/2-foot-diameter propellers. The technical problems discussed are grouped in these areas: aerodynamics—transition, rate of descent, base drag, and ground effect problems; aeroelasticity—complexity of flutter problems and flutter model testing; flying qualities—the difficulty of establishing adequate design criteria for the hovering-transition region, all-weather flight requirements, longitudinal control problems affected by aeroelastic problems, and lateral-directional problems due to the severe cross-coupling inherent in the configuration; and propulsion—propeller vibration effects, particularly 2P and 4P, as well as transmission system dynamics which required the solution of equations involving as many as 50 degrees of freedom. Finally, the results of ground tests and flight tests are discussed. Author

N65-22906 British Aircraft Corp., London (England).
EFFECTS OF AIRFRAME AND POWERPLANT CONFIGURATION ON V/STOL PERFORMANCE
R. F. Creasey, N. W. Boorer, and R. Dickson *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 185–221 (See N65-22900 12-02)

This paper discusses the large range of layouts that were studied in relation to both strike and transport V/STOL requirements. The effects on performance of different powerplant arrangements are presented, taking account of the structural and aerodynamic effects on the airframe, which were produced by extensive design studies. The effects of changes in wing planform are shown, including the advantages of variable sweep wings, particularly for supersonic STOL designs or where overloading of a supersonic VTOL design is a frequent operational necessity. The complex interactions between the powerplant airflows and the normal lifting effects of the airframe have a considerable effect on performance. Typical results are presented for a variety of airframe–powerplant combinations. The inevitable performance penalty of VTOL is discussed, leading to the concept of a freighter–platform VTOL aircraft supporting a strike aircraft, which therefore does not suffer the built-in VTOL penalty. Author

N65-22908 Société Bertin et Cie, la Garenne-Colombes (France).
APPLICATIONS OF EJECTORS TO VERTICAL TAKE-OFF [APPLICATIONS DES TROMPES AU DECOLLAGE VERTICAL]
P. Guienne and M. Faure *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 255–275 refs In FRENCH; ENGLISH summary (See N65-22900 12-02)

The problems involved in the development of a lift system for V/STOL aircraft may, in some specific cases, be solved advantageously by the use of ejectors. Advantages of ejectors are: increase of thrust, lower noise level, and lower jet exit velocity and jet temperature. Drawbacks are their overall dimensions and weight. Another objection is that ejector utilization for lift is not yet supported by a long-standing experience, since the only one known is that of the Humming-Bird. Exploratory small-scale model testing was devoted to the ejector thrust increase and reduction of weight and overall dimensions. Preliminary designs were outlined for short takeoff and vertical takeoff. Ejector advantages and drawbacks in this case could thus be determined. Tests of full-scale ejectors supplied by a turbojet exhaust confirmed the results obtained in small-scale testing and confirmed their endurance. Author

N65-22909 Canadair, Ltd., Montreal (Quebec).
THE CANADAIR TILT-WING/DEFLECTED-SLIPSTREAM V/STOL PROTOTYPE PROGRAM
F. C. Phillips *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 277–307 refs (See N65-22900 12-02)

This paper summarizes the early work which led to the choice of the tilt-wing/deflected-slipstream configuration for future design studies of V/STOL transport. A description is given of aircraft of this type. The significant research and development achievements are outlined: development of aerodynamic methods; construction and use of a mobile rig for open-air testing of V/STOL models; construction and use of a rig for static-thrust testing of developmental propellers; and flight simulation, using both a fixed-base simulator and a variable-stability helicopter. The original concept of the CL-84 was considered as a small research vehicle. Its evolution into a larger machine, intended as an operational prototype, is outlined. An explanation is given of the relationship of the CL-84 to other V/STOL aircraft, with respect to performance and military roles. The CL-84 prototype aircraft is described in some detail. The makeup of the overall program is sketched; various program elements are commented upon. An outline of program experience is given, and the principal problems encountered are discussed. Author

N65-22910 Curtiss-Wright Corp., Caldwell, N. J. VTOL Systems Group

THE TRI-SERVICE X-19 V/STOL DESIGN CONSIDERATIONS AND FLIGHT TEST RESULTS

H. V. Borst *In* AGARD V/STOL Aircraft, Pt. 1 Sept. 1964 p 309–338 refs (See N65-22900 12-02)

The X-19 is a V/STOL aircraft capable of high subsonic cruise speeds and high load-carrying capacity and range. The aircraft has fixed tandem wings with four tiltable propellers mounted at the wing tips. The propeller shaft angle is approximately 90° at hover and 0° at cruise. The propellers provide the necessary lift and control forces at the hover and slow-speed conditions as well as the thrust and a small component of lift at the high-speed cruise condition. The unusual configuration of the X-19 resulted from special considerations of the problem of hovering in low-speed flight and the importance of high hover efficiency with good performance at the cruise condition. The X-19 design concepts are discussed, and some of the special wind tunnel data are presented. The special problems encountered with the unusual configuration of the X-19 which are complicated by the large speed range of the aircraft are also discussed, and pertinent data presented. The overall characteristics of the aircraft and the compliance with specifications in hover flight and cruise flight are presented. Since the X-19 has been built and is now entering its first flight test program, the existing characteristics of the aircraft are compared with predicted performance and stability results, and any discrepancies are explained. Author

N65-22911 Societe Anonyme des Ateliers d'Aviation Louis Breguet, Seine-et-Oise (Paris).

TEST FLIGHTS OF 940 AND 941 BREGUET AIRCRAFT [ESSAIS EN VOL DES AVION BREGUET, 940 ET 941]

J. Czinczenheim and G. Joyeuse *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 339–368 In FRENCH; ENGLISH summary (See N65-22900 12-02)

A brief description is given of the main characteristics of the two airplanes: mechanical interconnection, countershafts and transmission gear-boxes, reducers, and multiple uses of the propellers as high lift flaps and controls. Investigations and preliminary tests were conducted prior to flight testing: (1) conventional wind-tunnel tests; (2) simulator tests, free-flight models; (3) mechanical full-scale bench testing, including propulsion system development and engine failure investigation; (4) piloting techniques and takeoff procedure, including selection of takeoff safety speed; (5) engine and propeller failure; (6) capability for tight turns with little bank and spiral trajectory; (7) takeoff stability and control; (8) piloting technique and landing procedure; and (9) use of the incidence angle as a main piloting parameter (BIP) with means for correcting the glide slope—by single lever, air-brakes, and wide visibility angles, steep and shallow glide paths, touchdown accuracy, and landing aids. Advantages of a low-speed takeoff and approach in poor visibility conditions were shown. The problem of using full throttle again during landing was investigated. Flight properties of STOL aircraft during approach were observed. Use of television for flow visualization studies was considered. The STOL aircraft is compared with VTOL and conventional aircraft. Author

N65-22912 Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

VTOL TESTING IN THE UNITED STATES

Paul E. Haueter and Louis C. Setter *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 369–390 (See N65-22900 12-02)

This presentation covers briefly VTOL test-bed history leading up to present operational suitability tests of the XC-142. The majority of it is on philosophy and concept of the XC-142 program. The VTOL flight test techniques are only partially developed, particularly in the conversion from hover to forward flight. Measurement of angle of attack and airspeed, a difficult problem, is critically important for tilt wing aircraft. Current thinking and practice in the area of flight test technique are reviewed and problem areas defined. The X-19 and XC-142 test plans are summarized to illustrate the procedure and philosophy used. Both test plans were written to define the operational feasibility of these two configurations. Observations include the most serious limitations of the VTOL concept. Author

N65-22913 Entwicklungsring Süd, Munich (West Germany).

THE DEVELOPMENT OF VTOL AIRCRAFT WITH TURBOJET ENGINES IN THE FEDERAL REPUBLIC OF GERMANY

Karl Schwärzler *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 391–417 (See N65-22900 12-02)

Development and testing of the German vertical takeoff and landing (VTOL) aircraft, VJ 101 C, is described. Distinguishing features of this supersonic aircraft are tilting engines at the wing tips, and control by thrust modulation during hovering flight and transition phases. A full-scale experimental model was constructed for flight testing of VTOL flight phases at speeds around Mach 1. A narrative of the initial free-flight, telemetry, vertical, horizontal, and high-speed flight tests is given. Numerous photographs show the aircraft during development and during operation. J.M.D.

N65-22914 De Havilland Aircraft Co., Ltd., Downsview (Ontario).

MODULATED THRUST TO IMPROVE STOL AIRCRAFT PERFORMANCE (A FLIGHT TEST EVALUATION)

G. W. Johnston *In* AGARD V/Stol Aircraft, Pt. 1 Sep. 1964 p 419–448 refs (See N65-22900 12-02)

For a conventional short takeoff and landing (STOL) propeller aircraft, use of light weight lifting turbine engines as auxiliary power sources during landing maneuvers was studied. It was found that through combined action of the deflected slipstream and reverse jet, the aircraft can better exploit the large low speed lifting potential that exists during landing maneuvers. Experimental results for both model and full-scale aircraft indicate various possible improvements. Scope of possible improvements is discussed on the basis of landing trials of the aircraft. Integration of auxiliary engine concept with the lift augmentation obtained by means of flap boundary layer control, and problems which appear at high values of auxiliary thrust-to-weight ratio, are discussed briefly. J.M.D.

N65-22915 Ernst Heinkel Aktiengesellschaft, Stuttgart (W. Germany).

V/TOL CONTROL SYSTEMS, ESPECIALLY CONTROL BY THRUST MODULATION

X. Hafer *In* AGARD V/STOL Aircraft, Pt. 1 Sep. 1964 p 449–473 refs (See N65-22900 12-02)

Control of vertical takeoff (VTO) and vertical takeoff and landing (VTOL) aircraft was studied using various sources of experimental results. Control system requirements, with respect to guidance, frequencies, attitude control, behavior in event of engine failure, and reliability, are reviewed. Generation of control moments by jet vectoring, jet deflection, jet nozzles, and thrust modulation, is discussed. Optimization of control systems by stabilization devices and through asymmetrical thrust diminution is evaluated. Control system of the German VTOL aircraft, VJ 101 C X-1, is described, and system characteristics derived from analog computer studies, simulation, and flight tests, are presented. J.M.D.

N65-23017# Congress. House. Committee on Science and Astronautics.
PANEL ON SCIENCE AND TECHNOLOGY, SIXTH MEETING
Harold A. Gould Washington, GPO, 1965 96 p Report of the Comm. on Sci. and Astronautics, U.S. House of Representatives, 89th Congr., 1st Session

The Committee on Science and Astronautics of the U.S. House of Representatives presents a summary of the many views on astronautics discussed in a meeting of the Panel on Science and Technology. Three general objectives for improvement of our national civil aeronautical stature are (1) to insure the best air transportation system for our economy; (2) to insure that U.S. aeronautical development is responsive to demand and continues its leadership in the domestic and world markets; and (3) to maintain world leadership in technical matters to insure technological competence in aeronautical development. Indications are that not enough research is being done in hypersonic propulsion and that the aeronautical research and development capability of NASA is not being used to maximum capacity. The area of V/STOL research and development requires lighter powerplants, lighter structures, and better stability and control. The research and design of a superior supersonic transport proceeds slowly, and it is felt that this aircraft's application is limited to overseas and transcontinental routes. G.G.

N65-23044# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EJECTION SEAT WITH HINGE SUSPENDED POWDER ACCELERATOR
N. V. Kirsanov 11 Feb. 1965 5 p Transl. into ENGLISH from Russian Patent no. 160956 (Appl. no. 788059/40-23, Jul. 21, 1962) 2 p
(FTD-TT-64-943/1+2; AD-611532)

The ejection seat is characterized by the fact that for the purpose of increasing the height of ejection and automatic stabilization of the ejected object in flight, the powder accelerator is hinge suspended above the c.g. of the seat and is provided with a stabilizer (aerodynamic flaps). TAB

N65-23112# Air Proving Ground Center, Eglin AFB, Fla.
PRELIMINARY FIT TESTS OF U.S., BRITISH, AND FRENCH ROCKET LAUNCHERS (FIT TEST OF FRENCH ROCKET LAUNCHER MATRA 150 ON F-100D AND F-105D AIRCRAFT)
James M. Karth Feb. 1964 13 p
(APGC-TDR-63-11, Suppl. 1; AD-429405)

From the results of the test it was determined that this rocket launcher is not physically compatible with either aircraft because the launcher suspension lugs do not meet the requirements in that they are too narrow to accommodate the rack hooks and are not interchangeable. In addition, the electrical connections of the rocket launcher are not compatible with those used on either aircraft. Compatibility of the launcher with these aircraft could possibly be achieved through modification of the launcher or utilization of suitable adapters. Author

N65-23252*# Clark, Buhr and Nexsen, Norfolk, Va.
STUDIES OF SONIC BOOM INDUCED DAMAGE
Washington, NASA, May 1965 49 p
(Contract NAS1-1166)
(NASA-CR-227) CFSTI: HC $3.00/MF $0.50

The results of sonic boom damage complaints from 17 supersonic flights were investigated to establish criteria for structural investigations of sonic boom damage. It was observed that the damage normally occurs at stress points within a structure. Overpressures from sonic booms have the capability of triggering cracking or failure of stressed portions of plaster; cracking or failure of improperly installed glass; and cracking at a stressed condition in a structure and/or causing an existing crack to open up or grow longer. About 90% of all complaints occurred within a corridor of 12 miles on each side of the aircraft flight track. It was concluded that sonic boom overpressures generated by aircraft operating at 1.5 to 2.0 Mach and at altitudes of 31 000 to 41 000 feet are not of sufficient magnitude to cause structural damage to well constructed and well maintained buildings. G.G.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-22228# General Electric Co., Schenectady, N. Y. GE Research Lab.
A NEW HIGH PERFORMANCE FUEL CELL EMPLOYING CONDUCTING-POROUS-TEFLON ELECTRODES (NIEDRACH-ALFORD) AND LIQUID ELECTROLYTES. SATURATED HYDROCARBON FUEL CELL PROGRAM
L. W. Niedrach and H. R. Alford [1963] 32 p refs
(Contract DA-44-009-AMC-479(T); ARPA Order 247)
(AD-611558)

A low temperature, aqueous electrolyte fuel cell employing new, conducting-porous-Teflon electrodes is described. The new electrodes show excellent performance characteristics with a variety of fuels (including hydrocarbons) and with both oxygen and air as the oxidant. Preparation methods are discussed, and performance data obtained with ambient temperature. Hydrogen–oxygen and hydrogen–air cells are presented to illustrate their properties. Author

N65-22284 Army Electronics Labs., Fort Monmouth, N. J.
PERFORMANCE OF THE GERMANIUM-PHOTOVOLTAIC CELL UNDER INTENSIVE MONOCHROMATIC LIGHT
E. Kittl, S. J. Shapiro, and K. J. Brzonkala *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 105–120 refs (See N65-22275 12-34)

Two major limiting factors responsible for the low conversion efficiency of silicon cells (15%) were investigated. These are (1) the spectral energy distribution of the incident light and its relationship to the p–n junction current collecting mechanism, and (2) the limitation of the junction potential on doping level and material characteristics. The experimental results showed that maximum monochromatic conversion efficiencies occur at a wavelength of 1.5 microns and reach projected values of 30% assuming electrical output of 0.3 V open circuit and 0.7 curve factor at current densities in the order of 1.0 amp/sq cm. Compared with low intensity results, the photon response of these cells showed a remarkable improvement at these higher intensities in the region of 0.8 to 1.3 microns. Further, spectral matching of source and photovoltaic converter cell becomes less critical at high injection levels. Also, there are indications that a germanium cell may perform as well as or better than the silicon or gallium arsenide cells in highly concentrated sunlight. Laser experiments have yielded

a conversion efficiency of 35% at 1.055 microns. This higher efficiency correlates well with the data obtained in these experiments. E.E.B.

N65-22352# Eagle-Picher Co., Joplin, Mo. Couples Dept.
INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/MAGNESIUM PERCHLORATE BATTERIES Quarterly Progress Report, 1 Jul.-30 Sep. 1964
James Sharpe 30 Oct. 1964 29 p refs
(Contract DA-28-043-AMC-00221(E))
(QPR-1; AD-461485)

This report describes research and development of magnesium-magnesium perchlorate batteries. Data concerning voltage and temperatures vs. type of magnesium alloy are presented. Performance characteristics of HgO and other cathode materials at low and high temperatures are discussed. Variations of electrolyte concentration and freezing point depression are also discussed. An experimental 11-cell battery for the AN/PRC-62 application was fabricated and tested in an insulating container at −40° F. The unit, with AZ 31 magnesium alloy anodes, mercuric oxide cathodes and sufficient dry magnesium perchlorate for a four normal electrolyte solution, was activated with +40° F tap water. It performed satisfactorily, yielding 41 watt-hours per pound over a 20-hour discharge period at −40° F, giving a good preliminary indication of the feasibility of this system. Author

N65-22365*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALKALI-METAL TURBINE GEOMETRY AS AFFECTED BY BLADE-SPEED LIMITATIONS
Arthur J. Glassman Washington, NASA, Apr. 1965 18 p refs
(NASA-TN-D-2777) CFSTI: HC $1.00/MF $0.50

This study was undertaken to determine the general geometry characteristics of alkali-metal turbines as they are affected by blade-speed limitations that might result from moisture-caused erosion effects. Selection of turbine temperature ratio was made on the basis of reduced moisture levels in the turbine. Dual turbines with intermediate moisture separation as well as single turbines were studied. Rotative speeds were selected to be compatible with common alternator frequencies. Turbine-geometry characteristics were determined for 1-MW power systems using sodium, potassium, rubidium, and cesium as working fluids at a turbine-inlet temperature of 2500° R. The requirements for favorable turbine geometry set a lower limit on blade speed. These lower limits were in the 250- to 400-fps range. The required number of turbine stages depends to a large extent on blade speed, as well as on the selected fluid. Reduction of blade speed results in a rapidly increasing number of stages. Blade speeds, however, can be limited to values below about 500 fps while geometrically feasible turbines are still maintained. Designs featuring both small and large numbers of stages were evolved. With a small number of stages, however, turbine performance can be considerably poorer than with a large number of stages. Author

N65-22371*# Alfred Univ., N. Y.
FUEL CELL RESEARCH. AN INVESTIGATION OF NON-STEADY-STATE OPERATION Third Semiannual Report, Jun. 1-Dec. 31, 1964
T. J. Gray, A. A. Schneider, and R. B. Rozelle [1964] 38 p refs
(Grant NsG-384)
(NASA-CR-54300) CFSTI: HC $2.00/MF $0.50

The discharge characteristics of pulse loaded hydrogen-oxygen fuel cells and fundamental galvanostatic reactions of simplified single electrodes under corresponding pulsed operating conditions are being investigated. The power output of the pulse loaded cell was studied in respect to the duty time of the pulse, the frequency of the pulse, and the percent duty cycle of loading at a wide range of polarizing current densities. Moderate improvements of power output (10% to 15%) have been realized with existing equipment, and greater improvement is expected using the new polyphase interrupter loading unit. In preparation for the individual electrode reactions study, the usefulness of galvanostatic techniques in studying the constitution of the catalyst under specific operating conditions was demonstrated. Fundamental measurements on palladium-gold and platinum-palladium alloys are reported. The data obtained on the palladium-gold system in H_2SO_4 electrolyte support a previously proposed mechanism whereby the formation of Au_2O_3 occurs throughout the formation of a chemisorbed oxygen layer on the gold surface. To explain the long period (~24 hr) of low current density (up to 0.2 ma/cm^2) reactions, it is suggested that some of the Au_2O_3 decomposes to reform the reactant and oxygen. M.P.G.

N65-22448* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC MACHINES WITH EVAPORIZATON AND UNIVERSAL COOLING SYSTEMS FOR FLYING MACHINES
V. A. Vinokurov, F. I. Golgofskiy et al 1 Apr. 1965 11 p Transl. into ENGLISH from Elektrotekhnika (USSR), no. 1, 1965 p 5-7
(FTD-TT-65-290/1+2; AD-613464)

Elucidated are problems of developing cooling methods in small electric machines (motors), used on flying machines. A new cooling system is proposed. TAB

N65-22545# Flow Technology, Inc., Tempe, Ariz. Engineering Dept.
THE DESIGN, CONSTRUCTION, TESTING AND DELIVERY OF A BALLISTIC FLOW PROVER SYSTEM Final Report, 1 May 1964-1 Feb. 1965
Edward E. Francisco, Jr. Edwards AFB, Calif., AF Rocket Propulsion Lab., Mar. 1965 63 p refs
(Contract AF 04(611)-9895)
(AFRPL-TR-65-60; AD-460821)

This report describes the bipropellant in-line flowmeter proving system, Ballistic Flow Prover, intended for use upon rocket static test stands where it will supply calibration check points to verify the performance of operational in-line turbine type flowmeters. The Ballistic Flow Prover performs its function by allowing temporary freedom to a normally latched piston, which in turn moves a fixed distance downstream in perfect unison with the flowing propellant. The downstream motion of the freed piston is observed by detectors at several fixed positions which precisely delineate specific volumes of displaced or passed fluid. The piston position detectors supply electrical pulses to an oscillographic recorder which is simultaneously recording the pulse output of the turbine flowmeters under observation, the output from a high-response-speed nuclear density gage, both propellant temperatures, and a precise timing signal. The recorded electrical pulses allow the accurate verification of the observed flowmeters performance. An important performance characteristic of the prover system is that it does not introduce an excessive pressure pulse or flow perturbation to the operational propellant flow plumbing, when it is accomplishing its normal function. Author

N65-22555*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN I ELECTRICAL POWER AND SYSTEMS INTEGRATION SA-5 THROUGH SA-7
A. A. Conway and H. K. Bennett 25 Mar. 1963 75 p
(NASA-TM-X-56314; MTP-ASTR-E-63-5) CFSTI: HC $3.00/MF $0.75

The Saturn SA-5 through SA-7 electrical system networks, hardware, and the integration scheme used to bring vehicle subsystems together as a functional electrical unit are presented. The various subsystems to which electrical power is supplied are pointed out; these subsystems are described to define the systems that require electrical integration. A simplified electrical interconnection diagram of the system is included to show the integration scheme. The integration components are distributors, flight sequencer, flight sequencer slave, exploding bridgewire, switch assemblies, timers, and plug "J" boxes. The power components are batteries, 56-volt power supplies, 2400-volt power supplies, control voltage power supplies, master measuring voltage supplies, and measuring voltage supply modules. Descriptions and illustrations of these components are included. Simplified circuit examples and descriptions of the circuits through the various distributors, switch assemblies, and plug "J" boxes are given. Author

N65-22618*# Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS Quarterly Report, 1 Jan.–31 Mar. 1965
M. Klein and E. Findl 15 Apr. 1965 39 p ref
(Contract NAS3-2781)
(NASA-CR-54380; EOS-4110-QL-3) CFSTI: HC $2.00/MF $0.50

Major aspects of the design for the 500-W multicell unit were completed. Single cell testing is continued in order to obtain additional information on electrode, electrolyte and asbestos matrix structures. Life testing of single and multicell units was initiated. A single cell was cycled continuously for 205 cycles at which point the test was discontinued. A multicell, 75-W unit is on continuous cycle and has exceeded 200 cycles, with no degradation performance. The instrumentation and control panel for testing of the 500-W unit has been designed, and fabricated. Author

N65-22656*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
LOW VOLTAGE DC TO DC CONVERTER-REGULATOR WITH MINIMUM EXTERNAL MAGNETIC FIELD DISTURBANCE Third Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
Kenneth J. Jenson and John T. Lingle [1965] 55 p
(Contract NAS5-3899)
(NASA-CR-62445) CFSTI: HC $2.00/MF $0.50

The dual section bucking choke coil was fabricated and assembled into the low input voltage converter–regulator. A preliminary mapping of the magnetic field disturbance at a radius of 2.5 inches from the device axis indicated that the external magnetic field disturbance around the coaxial converter section was satisfactory. However, the magnetic field disturbance around the choke coil was much higher. Performance tests also showed that the choke coil had excessive eddy current losses. Author

N65-22657*# Yardney Electric Corp., New York.
INVESTIGATION AND IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Quarterly Report No. 2, Oct.–Dec. 1964
Z. O. J. Stachurski and G. A. Dalin [1964] 40 p
(Contract NAS5-3873)
(NASA-CR-62446) CFSTI: HC $2.00/MF $0.50

The rate of growth of zinc deposits was studied in cycled silver–zinc cells, microcells, and in a special tunnel cell, to determine the effect of the nature of the separator on the growth mechanism and to determine whether surfactants could affect the nature of the growth. It was found that in actual silver–zinc cells as well as in microcells, zinc penetration occurred by the deposition of heavy sponge nodules within the separators. In silver–zinc cells, penetration took place by growing into the separator and not by mechanical puncture. In microcells, the underlying mechanism of penetration through cellophane, PVA, and grafted polyethylene was basically similar. The surfactant Igepal CO-730 changed the morphology of the deposits from heavy sponge to dendritic form. The form of the deposit was influenced simultaneously by the surfactant and the separator used. The separator influenced the deposit through control of the rate of diffusion of zincates. The rate of growth of zinc deposits in a special tunnel cell was nearly constant with time. Results of studies on zinc deposition kinetics, absorption of surfactants on a dropping mercury electrode, and absorption of zincates in separators, are also presented. S.C.W.

N65-22659# Rocketdyne, Canoga Park, Calif.
FEASIBILITY INVESTIGATION OF A MOVING BELT RADIATOR Quarterly Progress Report No. 3, 10 Sep.–9 Dec. 1964
Jan. 1965 268 p refs
(Contract AF 33(615)-1576)
(R-5670-3; AD-609926)

This report covers research on the feasibility of a novel concept for the rejection of waste heat in space, the moving belt radiator. Chief concerns of the program are materials compatibility, thermal conductance between surfaces, and antifriction bearing operation, all at high temperature in a hard vacuum. The materials compatibility and heat-transfer investigations in the reciprocating-contact testers were continued; the first of two new bearing test rigs was assembled and the first bearing test initiated; modifications to the small-scale model were completed and several successful tests were completed; and analytical optimization studies of the belt radiator were continued. Author

N65-22734 Harry Diamond Labs., Washington, D. C.
CONTROL, AMPLIFICATION, AND FLUIDS
Billy M. Horton *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 9–21 (See N65-22732 12-34)

Fluid amplification is discussed as a means of controlling and increasing the kinetic energy of a fluid system. A fluid amplifier is a conduit device without moving parts, in which nozzles are set in a push–pull arrangement to blend their separate flows; energy gain is accomplished without concomitant energy loss in the system. A digital computer and a small artificial heart pump, which are applications of the principle of fluid amplification, are described. Diagrams show jet-relay devices which control flow but do not increase energy. A brief history (in nontechnical language) of pneumatic methods is given. J.M.D.

N65-22769# Pennsylvania State Univ., University Park. Mineral Industries Experiment Station
FUEL CELLS Semiannual Progress Report, Jul.–Dec. 1964
L. G. Austin, H. Lerner, and S. Almaula [1964] 51 p refs
(Contract DA-49-186-AMC-146(D))
(AD-612276)

The report summarizes work on the mode of operation of porous electrodes. It also includes a number of literature abstracts prepared as part of the review program. TAB

N65-22895# Rocketdyne, Canoga Park, Calif.
FEASIBILITY INVESTIGATION OF A MOVING BELT RADIATOR Summary Report, 15 Mar. 1962–15 Apr. 1963
J. A. Speeds and L. E. Fuller Wright-Patterson AFB, Ohio, ASD, Aug. 1963 222 p refs
(Contract AF 33(657)-8127)
(R-3668-4P; ASD-TDR-63-551; AD-611574)

This report covers the first year of a research program on the feasibility of a novel concept for the rejection of waste heat in space—the moving belt radiator. Chief concerns of

the program are (1) materials seizure, (2) thermal conductance, (3) fatigue of the belt materials, and (4) high-temperature, high-speed bearings, all in the hard vacuum environment of space. The facility required for achieving the ultrahigh vacuum in a clean environment was completed, and three ultrahigh vacuum seizure and heat transfer test rigs were put into operation. In addition, two ultrahigh vacuum, high-temperature bearing test rigs were built, and bearing material tests were initiated. Author

N65-22971*# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Final Report
Warren J. Deshotels and Frank Augustine 30 Oct. 1964 37 p refs
(Contract NAS3-2795)
(NASA-CR-54343) CFSTI: HC $2.00/MF $0.50

A process for fabricating thin-film CdS backwall solar cells on polyimide plastic foil substrates was developed. This process consists of vacuum evaporating approximately 50μ of indium-doped CdS onto a lapped surface of 0.002 in. thick film at 200°C, processing a barrier on the CdS by applying a water slurry of Cu_2O and heating, contacting the barrier with conductive silver paint, and then laminating the cell to an 0.001 in. thick film of Mylar using a nylon plastic adhesive. Other transparent insulating substrate materials were evaluated as substrates for backwall film cells. Factors affecting the vacuum evaporation of CdS films were studied and a tradeoff made between low film resistance yielding low open circuit voltages, and higher film resistance causing appreciable series resistance effects. The plastic substrate cell has reached the 1.5% to 2.0% efficiency level. Further improvements are anticipated since efficiencies greater than 4% have been obtained with insulating glass substrate cells. Author

N65-22973*# Northrop Space Labs., Huntsville, Ala.
APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES. RADIOISOTOPE POWER SYSTEMS FOR A LUNAR VEHICLE
W. L. Breazeale Mar. 1965 44 p refs
(Contract NAS8-11096)
(NASA-CR-61046) CFSTI: HC $2.00/MF $0.50

The advantages and feasibility of combining a fuel cell with each of five radioisotope electric power systems are investigated. The five nuclear systems considered are a Brayton cycle system, a Mercury–Rankine cycle system, a Dowtherm–Rankine cycle system, a Stirling engine system, and a thermionic system. The optimized system weight for each fuel cell–nuclear system is calculated for the MOLAB mission, and weight savings of 500 to 1020 lb are realized over an all fuel cell system for the mission. In addition to the MOLAB mission, similar calculations are made for other missions. Also the competitive regions for fuel cells and for nuclear systems are established. Discussion of advantages other than the weight savings afforded by a nuclear–fuel cell system are included. Author

N65-22974*# Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
PNEUMATIC NUTATOR ACTUATOR MOTOR Third Quarterly Report
G. R. Howland 31 Mar. 1965 27 p
(Contract NAS3-5214)
(NASA-CR-54382; BPAD-864-15664R) CFSTI: HC $2.00/MF $0.50

The mechanical components of the actuator hardware were assembled and tested. Commutation was accomplished by a mechanical valving assembly which was externally driven. The maximum obtainable torque was measured for various input speeds. The pure fluid commutation plates were assembled and tested. Optimization of the bleed orifice sizes was obtained. A discussion is presented of possible methods of improving the motor performance. Initial testing and adjustment of the complete commutation logic circuit is described. Measurements of the logic circuit output indicate that the circuit will be capable of operating and controlling the motor. S.C.W.

N65-22998# National Aerospace Lab., Tokyo (Japan).
AN INVESTIGATION OF THE HIGH SPEED AXIAL FLOW TURBINE
Tadao Torisaki, Hiroyuki Nose, and Mitsuo Morita 1964 23 p refs In JAPANESE; ENGLISH summary
(NAL-TR-69)

This report presents the results of detailed traverses made in the flow past a three-dimensional turbine nozzle cascade. The basic blade profile used in this cascade is the T–6 profile. The experiment was conducted by varying the nozzle exit Mach number from 0.4 to 1.1. The relatively poor performance discovered in the transonic flow range is mainly due to the separation of the flow from the suction surface of blades. Author

N65-23063*# General Electric Co., Pittsfield, Mass. Ordnance Dept.
DIRECT CURRENT TORQUE AMPLIFIER FOR DRIVING A GYRO-STABILIZED PLATFORM Final Report
H. L. Broverman 12 Jun. 1964 29 p
(Contract NAS8-5421)
(NASA-CR-62469; FDU-64-7) CFSTI: HC $2.00/MF $0.50

Design of a dc amplifier which has high power efficiency, which is small enough for gimbal mounting, and which has various specified performance characteristics, is presented. Primary elements of this design are integrated circuit differential amplifiers for low level gain, a thin-film assembly for high-voltage low-power components, and a pulse width modulated power discrete output stage. Feedback around the complete amplifier provides linearity and gain stability. All components are mounted on a double-sided printed circuit board, resulting in a small, compact hydrid module capable of being operated either unpotted or potted in epoxy. Production of the amplifier is difficult but can be made easier by replacing the integrated circuits with discrete amplifiers, or by improvement in quality of the integrated differential amplifiers. For flight units, a new concept of pulse width modulation is recommended. Refinements are suggested for other components. Performance data are given for an assembled module. J.M.D.

N65-23081# General Electric Co., Syracuse, N. Y. GE Electrons Lab.
RESEARCH ON THIN FILM POLYCRYSTALLINE SOLAR CELLS Final Report, 1 Sep. 1962–31 Dec. 1964
Richard W. Aldrich and Dominic A. Cusano Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Feb. 1965 192 p refs
(Contract AF 33(657)-10601)
(AFAPL-TR-65-8; AD-611535)

Large-area (56 cm^2) cells that were 4.6% efficient and a solar panel—1/2 ft^2 in area—were fabricated. On the average, the efficiency, the power output per unit weight, and the yield of large area solar cells made from cadmium telluride films all increased monotonically. The composite objective was the development of lightweight, flexible, solar cells of approximately 5% maximum efficiency. The semiconductor material was to be polycrystalline cadmium telluride. The cells were to withstand, or show promise of withstanding, without deterioration a normal laboratory environment, particle and ultraviolet radiation, high and low temperatures, and vacuum. Investigations undertaken to achieve such large area cells include studies of

photovoltaic junctions, film growth techniques, collector electrodes, collector busbars, and capsulation techniques. Author

N65-23095# Radio Corp. of America, Lancaster, Pa. Electronic Components and Devices Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN IMPROVED THERMIONIC ENERGY CONVERTER Third Quarterly Technical Report, 1 Jan.–31 Mar. 1965
15 Apr. 1965 33 p
(Contract AT(30-1)-3429)
(TR-3429-3)

Emphasis was placed on the evaluation of (1) reservoirless converters having various emitter and collector materials with radioactive and nonradioactive cesium; (2) reservoirless converters operated with high envelope temperatures; (3) variable volume converter performance; (4) life testing of reservoirless converters, and (5) post-test analysis of converters. As a result of these analyses, suggested modifications for extending the life and reliability of reservoirless converters include (1) substitution of kovar structures by nickel to prevent absorption of cesium, and the use of tungsten emitters and molybdenum collectors; (2) installation of a modified 0.010 inch thick heat dam to prevent permeation of cesium through the grain boundaries; and (3) assembling and welding of components in an inert atmosphere to eliminate residual oxides in the weld regions. G.G.

N65-23142# Dynatech Corp., Cambridge, Mass.
EVALUATION OF A SUPERCONDUCTING ROTATING ELECTRIC GENERATOR Third Quarterly Report
C. J. Oberhauser, E. F. Doyle, and R. L. Mela Jan. 1964 34 p refs
(Contract AF 33(657)-11062)
(Rept.-451; AD-430128)

The object is to determine the feasibility of the application of superconductor technology to the generation of electrical power by rotating electromagnetic devices. Since the anticipated use of such a generator is for long missions, a refrigerator with associated equipment must be part of the package. The work includes analytical and design studies of both electrical and mechanical components. The program was divided into three parts: initial design study, supporting tests, and second-round design. This document reports further progress on the supporting tests and deals with the initial phases of the second-round design. Author

N65-23193*# Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
FLUID STATE AMPLIFIER AND COMPENSATION FOR THE MODEL NV-B1 GIMBAL ACTUATOR Final Report, 29 Jun. 1964–29 Mar. 1965
G. R. Howland 12 Apr. 1965 81 p
(Contract NAS8-5407)
(NASA-CR-62522; BPAD-864-15651R) CFSTI: HC $3.00/MF $0.75

This report covers analysis, design, and test of a pure fluid amplifier, servovalve and compensation network for use with the Model NV-B1 pneumatic actuator for thrust vector control of the J-2 rocket engine. The amplifier was designed as a breadboard device to demonstrate the feasibility of replacing the electronic components and the spool valve of the actuator by pure fluid components of the vortex design. Results indicated that such a concept is feasible and gave reasonably good dynamic performance. A follow-on development program described optimizes the amplifier system design and performance. Author

N65-23275*# Yardney Electric Corp., New York.
RESEARCH AND DEVELOPMENT STUDY OF THE SILVER-CADMIUM COUPLE FOR SPACE APPLICATION Final Progress Report, 1 Jul.–30 Sep. 1964
Allen Charkey and G. A. Dalin [1964] 34 p
(Contract NAS5-3452)
(NASA-CR-62610) CFSTI: HC $2.00/MF $0.50

The goal was to provide an insight into basic problems associated with the sealed silver oxide–cadmium system, under satellite operating conditions. Specifically, the orbital regimes which were used in cell evaluation were the 100-minute (35% depth of discharge) and 24-hour (70% depth of discharge) regimes. Two groups of cells operating on the short and long orbit regimes have completed 1400 and 160 cycles, respectively. Reference electrode readings during a recent deep cycle indicated that most short orbit cells were positive limited on charge and negative limited on discharge, while most long orbit cells were negative limited both on charge and discharge. Four of the long orbit cells failed to come up to voltage (1.6) on the first charge following the deep discharge; evidently this was due to silver shorting. Four short orbit cells selected at random were dissected after 1200 cycles to determine individual Cd electrode capacities and to study the plate structures by metallographic microscope. Author

N65-23276*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT ON FUEL CELL SYSTEMS Third Quarterly Progress Report, Period Ending Mar. 31, 1965
J. L. Platner 26 Apr. 1965 78 p
(Contract NAS8-2696)
(NASA-CR-62611; NAS8-2696-QPR-003) CFSTI: HC $3.00/MF $0.75

Progress is reported for the three major tasks: advancement of the state of the art of fuel cells; evaluation of breadboard models of fuel cell systems; and the building of a number of 2-kW fuel cell system models employing advanced technology. Specific items include a mathematical evaluation of several plate designs which resulted in the selection of a design that reduced the voltage drop per cell by 8 to 10 mV. Also, initial runs of a thermal analysis computer program for the analysis of a typical induct heater arrangement established the feasibility of this arrangement and the operating parameters. Further, design criteria for a static condenser–separator water recovery device were established, based on a mathematical model. The 29-volt, 1.8-kW breadboard system completed 700 hours of operation under load, producing 673 kWh of energy. An additional 28-volt, 2.0-kW breadboard system has operated 720 hours under load, giving 836 kWh of energy. The average cell efficiency of the second cell was 78% as compared with the previous model which gave an efficiency of 73%. E.E.B.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-22222# Radiation Research Associates, Inc., Fort Worth, Tex.
A COMPARATIVE STUDY OF RADIOACTIVE SOURCE ARRANGEMENTS FOR SIMULATING FALLOUT GAMMA RADIATION FIELDS

R. L. French 15 Jun. 1964 107 p refs
(Contract DA-49-146-XZ-254)
(RRA-T45; AD-612032)

Monte Carlo techniques were used in a study of three basically different approaches to simulating the gamma radiation environment near the air/ground interface due to fallout uniformly distributed on the ground surface. The energy and angular distribution of the photon flux at a receiver 3 feet above the ground due to a Co 60 point isotropic source also three feet above the ground and at separation distances of 100 to 800 feet was computed, and the results bore little resemblance to those from a uniform fallout field. Results computed for a receiver position three feet above idealized Ce 144, Cs 137, and Co 60 infinite plane sources on the ground indicated good simulation of the angular distribution of the gamma-ray dose and, except for energies greater than 1.25 meV, reasonable simulation of the energy spectra from fallout. A third source arrangement, called the "compact simulator", simulated the fallout gamma radiation environment equally well. In the compact simulator, an overhead slab of water acts as a reflector to simulate air scattering. Author

N65-22288 Army Natick Labs., Mass.
RADIATION BIODOSIMETRY AND SCREENING FOR RADIOPROTECTIVE COMPOUNDS
Hillel S. Levinson and Esther B. Garber *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 169–183 refs (See N65-22275 12-34)

The possibility that the release of intracellular substances from living cells might form the basis for a useful system of dosimetry was explored. Suspensions of bakers' yeast, Saccharomyces cerevisiae, were used in these investigations. This organism is produced under uniform conditions and is easily and inexpensively procured commercially. Further, upon radiation this microorganism releases easily measurable phosphate into the suspending medium. In every case the radioprotective substances—ascorbic acid, mercaptoethanolamine, sodium thioglycolate, thiourea, and cysteine—inhibited the release of yeast phosphate, although colony-forming capacity of the yeast cells was unprotected. The experimental data offer promise for use of the system in a screening procedure for radioprotective compounds. Tris and sodium cacodylate offer possibilities as simple broad range dosimeters. Irradiated tris buffer gave a positive ninhydrin test for amino-N, linear with dose from approximately 2×10^5 to 2×10^6 rads. Irradiated cacodylate gave a positive Fiske–SubbaRow test with a linear response to approximately 4×10^6 rads. E.E.B.

N65-22294 Walter Reed Army Inst. of Research, Washington, D. C.
A MORPHOLOGIC STUDY OF THE PATHOGENESIS OF EXPERIMENTAL CHOLERA IN THE INFANT RABBIT
H. Thomas Norris, Richard A. Finkelstein, and Helmuth Sprinz *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 247–259 refs (See N65-22275 12-34)

The morphologic response of the gastrointestinal tract of the 10-day old rabbit to intact and to ultrasonically disrupted cholera vibrios, to broth in which cholera vibrios have been grown for 18 to 24 hours, and to cholera endotoxin is reported. The morphologic response of the gastrointestinal tract of the suckling rabbit to viable cholera vibrios, ultrasonically disrupted cholera vibrios, and to sterile filtrates of broth in which cholera vibrios were grown resembled the acute phase of cholera in other experimental models and the human disease. All shared the same basic pathological picture. Throughout the disease the intestinal epithelium remained intact. It is through this intact epithelium that the cholerigenous moiety of the inocula acts causing copious diarrhea of fluid resembling rice water, accumulation of large amounts of fluid in the lumen of the large and small bowel, and death resulting from the severe dehydration. This cholerigenous moiety is absent in cholera endotoxin. Further, it was concluded that cellular, vascular, and neural factors all play a role in the pathogenesis of experimental and human cholera. E.E.B.

N65-22299 Army Biological Labs., Fort Detrick, Md.
THE PURIFICATION AND CHARACTERIZATION OF STAPHYLOCOCCAL ENTEROTOXIN B
Edward J. Schantz, William G. Roessler, Jack Wagman, Leonard Spero, David Stefanye et al *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 309–319 refs (See N65-22275 12-34)

A method is described for the purification of enterotoxin B from *Staphylococcus aureus* by chromatographic procedures employing carboxylic acid resins that results in higher purity and larger yields. The toxin was produced by culturing *S. aureus* strain for 18 hours with aeration in a medium containing 1% N-Z-amine A, 0.001% thiamin, and 0.001% nicotinic acid adjusted to pH 6.5. The culture was centrifuged to remove the bulk of the cells. After dilution with water, the toxin was removed from the culture with the resin partly neutralized to pH 6.4. The toxin was then removed from the resin by fractional elution with 0.5-molar sodium phosphate at pH 6.8 in 0.25-molar sodium chloride. The fraction containing the toxin was then dialyzed to remove the salts. The procedure was repeated at a slightly higher pH and the toxin adsorbed and chromatographed on a column of carboxymethyl cellulose. Physical and chemical characterization of the toxin and a biological evaluation are included. E.E.B.

N65-22304 Walter Reed Army Inst. of Research, Washington, D. C.
THE EFFECTS OF MASSIVE DOSES OF IONIZING RADIATION UPON CONDITIONED AVOIDANCE BEHAVIOR OF THE PRIMATE
Joseph C. Sharp and Joseph V. Brady *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 375–789 refs (See N65-22275 12-34)

The effects of massive and acute doses of whole-body X-radiation on the ability to accomplish relatively simple, highly motivated tasks requiring periodic response were investigated. Adult male primates (macaca mulatta), weighing from 3.8 to 5.2 kg were used for the experimentation. Procedures and results are given in detail. An important conclusion of the study was that for practical military purposes survival time will be less useful for military planning than behavioral indexes. This is particularly true following doses below 20000 R. At 10000 R the difference between survival time and the time when the monkey last performed within normal limits averaged about 7 hrs. At higher doses this difference became progressively less, so that at 40000 R there was a 6-hr difference. Doses of this magnitude resulted in marked behavioral disintegration within 30 minutes. E.E.B.

N65-22306 Armed Forces Inst. of Pathology, Washington, D. C.
HOMOGRAFT REJECTION IN THE FETAL LAMB
A. M. Silverstein *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 401–412 refs (See N65-22275 12-34)

Procedures were developed that permit orthotopic skin grafting of the fetal lamb in utero without the interruption of pregnancy. The fetus was found to reject orthotopic skin homografts applied at any time after the 77th day of gestation. Prior to this gestational age, grafts remained in place without stimulating any detectable immunologic response. Once the fetus achieves the ability to reject the graft, the process occurs

with the same competence and rapidity as in the adult. Graft rejection in the fetal lamb in unaccompanied by formation of plasma cells or by the production of typical immunoglobulins, thus supporting the suggestion that circulating antibody does not play an obligatory role in the process. Author

N65-22311 Army Biological Labs., Fort Detrick, Md.
GROWTH OF SELECTED ARBOVIRUSES IN SERUM-FREE SUSPENSION CELL CULTURES
H. R. Tribble, Jr., H. J. Hearn, Jr., S. C. Nagle, Jr., and W. T. Soper *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 469–481 (See N65-22275 12-34)

The ability of animal cell suspension cultures grown in three types of serum-free media to support the replication of Venezuelan equine encephalomyelitis virus was demonstrated. The interval of viral growth in the infected cultures was divisible into two phases, acute and chronic, separated into a transition phase. During the acute phase, large amounts of virulent virus were produced. The observed occurrences of a chronic state of infection in the cultures and the step-wise decline in virulence of the chronically produced virus for various laboratory hosts are described. Yellow fever virus replicated in HeLa and chick embryo cell lines. A widely differing qualitative response was detected because of the rapid selection of an immunogenic population in the chick embryo cells that was nonlethal for monkeys. In contrast, HeLa cultures produced a highly virulent population that rarely failed to infect without causing lethality in monkeys. E.E.B.

N65-22312 Army Medical Research Unit, Balboa Heights (Canal Zone).
THE EFFECT OF MIGRATING NEMATODE LARVAE AS A PROVOKING FACTOR IN VIRAL ENCEPHALITIS IN MICE
Bryce C. Walton *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 483–492 (See N65-22275 12-34)

The effects of intraperitoneal inoculation of mice with sublethal dosages of each of three neutrotropic arboviruses—Eastern equine encephalitis (EEE), Ilheus (Ilh), and Japanese B encephalitis (JBE)—were reported. These inoculations were timed to coincide with the migration of *Trichinella spiralis* larvae. Although minor variations were used in individual experiments, all were designed to compare effects among three groups of young adult male mice: the dual infection group, which received both *Trichinella* and the virus; the *Trichinella* control group; and the virus group. Young mice given a combined infection with *T. spiralis* and a neuropathogenic arbovirus extraneurally showed a much higher mortality rate than mice given either agent separately. Distinct differences in the degree of this synergism were apparent with different viral agents, being very pronounced with EEE and quite minimal with Ilheus. E.E.B.

N65-22386# Naval Ordnance Test Station, China Lake, Calif. Underwater Ordnance Dept.
A BIBLIOGRAPHY OF CETACEA, LITERATURE PUBLISHED BETWEEN 1949 AND 1963
Ina L. Squire, comp. Dec. 1964 121 p refs
(NAVWEPS-8645; NOTS-TP-3686; AD-613005)

The bibliography was compiled as part of a continuing program of Cetacea research initiated at the Naval Ordnance Test Station. The initial collection of references has been extended to include pertinent literature published between the years 1949 and 1962. It has been assembled in categories designed to assist investigators pursuing specialized aspects of Cetacean research TAB

N65-22392# Army Chemical Center, Edgewood, Md.
A SIMPLE METHOD FOR MEASURING PUPIL SIZE
Herbert Rakatansky and Lloyd E. Matter Jul. 1964 8 p
(CRDL-TM-2-3; AD-444280)

Measurement of minimal pupil size changes during drug exposure is often difficult. A method was developed utilizing a calibrated television system as a measuring tool. This apparatus permits simple, accurate and reproducible observations with minimal discomfort and danger to the subject. Cooperative subjects with light irises have been consistently measured to approximately 1/4-mm change in pupil size. Author

N65-22476# Mayo Clinic, Rochester, Minn.
END-EXPIRATORY PLEURAL PRESSURES IN DOGS IN SUPINE AND PRONE BODY POSITIONS STUDIED WITHOUT THORACOTOMY Final Report, 15 Jul. 1963–1 Nov. 1964
Wilhelm J. Rutishauser, Natalio Banchero, Anastasio G. Tsakiris, Ralph E. Sturm, and Earl H. Wood Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 31 p refs
(Contract AF 33(657)-8899; Grants NsG-327; NIH H-3532; AHS-CI-10)
(AMRL-TR-64-133; AD-613541)

Intrapleural pressures were measured simultaneously by saline-filled catheters from 2 to 5 different sites in the potential right pleural space of nine anesthetized dogs while the animals were supported in the supine and prone positions by means of molded half-body casts. Intrapleural tips of the catheters were placed at heart level in the cephalad-caudad dimension at ventral (retrosternal) and dorsal (paravertebral) sites in the thorax. The site of each catheter tip was measured from biplane X-rays taken in each position. The average vertical distance between the dorsal and ventral catheter tips was 10.6 (S_e of mean = 0.3) cm. In the supine position, mean end-expiratory pressure at the superior (ventral) catheter tip was −11.9 (= 0.7) cm, H_2O as compared to −5.0 (= 0.5) cm, H_2O at the dependent (dorsal) site giving an average gradient of 0.64 (= 0.04) cm, H_2O/cm, vertical distance between the two recording sites. The respective values in the prone position were: −9.0 (= 0.6) cm, H_2O superior (dorsal) site: +0.7 (= 0.05) cm, H_2O/cm, vertical distance. The slightly positive value for retrosternal pleural pressure and the greater dorsal-ventral gradient, when in the prone position, may be due to the weight of the heart. During the increase in weight induced by acceleration, these pressures were multiplied roughly in proportion to the G level and the difference in gradient between the two body positions was maintained. Author

N65-22501# Central Lab. for Radiological Protection, Warsaw (Poland).
THE EVALUATION OF RADIOLOGICAL PROTECTION CONDITIONS IN ISOTOPE LABORATORIES IN POLAND, IN 1958–1963 [ANALIZA STANU OCHRONY PRZED PROMIENIOWANIEM W PRACOWNIACH IZOTOPOWYCH W POLSCE W LATACH 1958–1963]
T. Musialowicz, S. Dyz, J. Jakubiak, and Z. Wanat 1964 34 p refs In POLISH; ENGLISH summary
(CLOR-34)

Radiation protection conditions in radioisotope laboratories are evaluated. The most important problem was the situation in establishments using radioactive luminous compounds. The prime problem at present is how to minimize exposure of persons working with radium applicators. Author

N65-22614*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY

Mar. 1965 145 p refs
(NASA-SP-7011(09)) CFSTI: HC $1.00/MF $1.00

An annotated bibliography covering aerospace medicine and biology entries introduced into the NASA Information System during February 1965 is presented. Included are references from Scientific and Technical Aerospace Reports, American Institute of Aeronautics and Astronautics Technical Information Service, and the Library of Congress. L.S.

N65-22615*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY
Apr. 1965 124 p refs
(NASA-SP-7011(10)) CFSTI: HC $1.00/MF $1.00

An annotated bibliography covering aerospace medicine and biology entries introduced into the NASA Information Service during March 1965 is presented. Included are references from *Scientific and Technical Aerospace Reports, American Institute of Aeronautics and Astronautics Technical Information Service,* and the *Library of Congress.* M.P.G.

N65-22616*# Marquardt Corp., Van Nuys, Calif.
STUDY OF EXTRATERRESTRIAL LIFE DETECTION CONCEPT
G. E. Ellis Dec. 1964 153 p *Its* Rept.-25146
(Contract NASw-810)
(NASA-CR-62003) CFSTI: HC $5.00/MF $1.00

A study was made of the Marbac detector cell concept to evaluate signal response time and level for all major categories of culturable, earth bacteria, including systematic parametric studies of nutrients and environmental factors. Oxidation-reduction potential studies verified that such techniques can be used to detect the presence of bacteria. The use of changes of oxidation-reduction potentials to detect microbial metabolism and growth was demonstrated in various types of microorganism-nutrient systems. The effects of certain primary variables, such as pH, temperature, concentrations and types of microorganisms and nutrients, growth factors, and gaseous environment were investigated for purposes of increasing the extent and rates of changes of oxidation-reduction potentials. Correlations were developed between oxidation-reduction potentials and bacterial counts. The reproducibility of potential readings was within a 20-millivolt range under favorable conditions. A broad spectrum of desert soils was inoculated into trypticase soy broth and potential changes as high as 690 millivolts were obtained. Studies of the effects of miniaturizing the test cells indicated that experimental cells containing 0.4 milliliter of nutrient and microorganisms could be operated to produce essentially the same changes in potential as larger cells containing 31 milliliters of solution and microorganisms. It was shown that various microorganisms can be detected using the anodic polarization method, as a result of their metabolic activities. A discussion of the preliminary developments in this polarographic method is presented.
S.C.W.

N65-22622*# National Aeronautics and Space Administration, Washington, D. C.
ON THE PHARMACOLOGICAL INFLUENCE OF THE KIDNEY FUNCTION [UBER DIE PHARMAKOLOGISCHE BEEINFLUSSUNG DER NIERENFUNKTION]
E. Starkenstein May 1965 4 p Transl. into ENGLISH from Arch. Exptl. Pathol. Pharmakol. (W. Berlin), v. 92, no. 1, 1922 p 2–3
(NASA-TT-F-9340) CFSTI: HC $1.00/MF $0.50

The rate is discussed of excretion of fluids by the kidney in terms of several parameters. The diuretic action of Atophan is exerted renally and not extrarenally as is the case with most other drugs. Author

N65-22642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEDICAL PRACTICE Selected Articles
2 Mar. 1965 18 p refs Transl. into ENGLISH from Vrachebnoye Delo (Kiev), no. 10, 1963 p 111–117
(FTD-TT-64-962/1; AD-612413)

CONTENTS:

1. TO THE VIBRATION-SICKNESS CLINIC A. M. Kakhana p 1–7 refs (See N65-22643 12-04)
2. FUNCTIONAL STATE OF THE CORTEX OF THE SUPRARENAL GLAND IN PATIENTS WITH VIBRATION SICKNESS OF THE SECOND AND THIRD STAGE A. A. Koval'chuk, G. P. Pidpalyy, and A. I. Postnyy p 8–14 refs (See N65-22644 12-04)

N65-22643# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TO THE VIBRATION-SICKNESS CLINIC
A. M. Kakhana *In its* Med. Pract. 2 Mar. 1965 p 1–7 refs (See N65-22642 12-04)

Clinical data on 65 males, subjected to vibration frequencies within the 30- to 250-cps limits, indicated definite changes in the peripheral nervous system and vessels. The character of the pain, the trophic breakdown on the skin of the wrists and of the nails, the secretion disturbances, and the vasomotor disturbances of the Raynaud syndrome type were among the symptoms noted. In the more advanced stages of the vibration sickness phenomena, diencephalous disturbances were observed in the breakdown of neurovascular regulation and metabolic endocrine functions; neurological damage was found in separate craniocerebral nerves in the form of anisocoria, insufficient convergence, and flattening of the nasolabial fold; and neuritis of the hearing nerves, constriction of the arteries, and reduced muscular force were also noted. Individual case histories are given, and brief reference is made to other research findings. M.G.J.

N65-22644# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNCTIONAL STATE OF THE CORTEX OF THE SUPRARENAL GLAND IN PATIENTS WITH VIBRATION SICKNESS OF THE SECOND AND THIRD STAGE
A. A. Koval'chuk, G. P. Pidpalyy, and A. I. Postnyy *In its* Med. Pract. 2 Mar. 1965 p 8–14 refs (See N65-22642 12-04)

Medical histories of 45 miners, who worked with high frequency pneumatic drills, were used in diagnosing stages of vibration sickness. Symptoms of second-stage patients included constant pain, paresthesia, and lowered pain sensitivity in the arms; lowered skin temperature of the fingers down to 22° to 23°; rise in pain sensitivity threshold to 0.8 to 0.9 mm, and functional disturbances of the central nervous system of an astheno-neurotic character. Third-stage victims suffered from constant hand pain, nighttime paresthesia, spastic and spasticoatonic states of the capillaries, lowered pain sensitivity of the chest, thickening of the interphalanx joints, and astheno-neurotic reactions. Analyses of clinical data showed inhibited functioning of the cortex of suprarenal glands, which progressed in proportion to the development of symptoms; this inhibition is apparently due to the development of hypoxemia. Functional reserves of the cortex are preserved in vibration sickness, but lowering is observed in patients subjected to long-term vibration effects. M.G.J.

N65-22653*# West Virginia Univ., Morgantown. Dept. of Theoretical and Applied Mechanics.
STRAIN RATE SENSITIVITY OF CERTAIN BIOLOGICAL MATERIALS Final Report
J. H. Mc Elhaney and E. F. Byars 1965 108 p refs
(Grant NsG-533)
(NASA-CR-62440) CFSTI: HC $4.00/MF $0.75

A high velocity air gun type testing machine was developed capable of performing constant velocity tests to strain rates of 4000/sec. Adjustable stops provided allow predetermined strains to be applied to miniature specimens. High frequency response instrumentation utilizing a piezoelectric load cell and capacitance displacement transducer was used. Load and displacement histories of fresh bovine femur bone, embalmed human femur bone, bovine tissue, nylon and aluminum were measured over a wide range of strain rates. Results are presented in the form of stress-strain diagrams at selected strain rates. Curves of various properties, as effected by rate of loading, are also provided. A critical velocity was noted for both types of bone in the neighborhood corresponding to a strain rate of 1/sec. A stress, strain, strain rate surface representation of the data is suggested and similarities between the dynamic response of bone, nylon and aluminum are noted. The intersection of this surface with planes parallel to the stress-strain coordinate plane were found to be exponentials. Author

N65-22655# National Aeronautics and Space Council, Washington, D. C.
SOVIET BIOASTRONAUTICS—1964
Eugene B. Konecci [1964] 10 p refs Presented to the Natl. Space Club, Washington, 15 Dec. 1964

Dr. Eugene B. Konecci, the National Aeronautics and Space Council, describes the development and results of the Russian bioastronautic research and manned space flights. The shirtsleeve environment and the mixed interdisciplinary crew capability of their space capsules offer a great potential for many investigations on man. The author does not believe that the Soviets will attempt manned extravehicular experiments until (1) they have developed a better space suit; (2) they have a better fix on the possible decompression sickness problems of decompressing from a sea-level atmosphere with nitrogen to a compatible space suit environment; and (3) the Gemini intentional decompression and extravehicular experiments have taken place. The importance of a more extensive free exchange of scientific information particularly in the bioastronautics field is pointed out. G.G.

N65-22724 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REACTION OF IRRADIATED ORGANISM WHEN AFFECTED BY ACCELERATION OF CRITICAL MAGNITUDE
B. I. Davydov, V. V. Antipov, and P. P. Saksonov *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 256-268 refs (See N65-22713 12-30)

Results are presented on experiments designed to study the tolerance of accelerations of critical magnitude (40 to 42 g) in animals irradiated with doses of 250 to 850 R. In comparison with the control test, elevated resistance on the part of the irradiated animals to acceleration is observed. An attempt is made to extrapolate the derived experimental data from animals to humans. Author

N65-22728# Joint Publications Research Service, Washington, D. C.
RECENT DEVELOPMENTS IN SOVIET MEDICINE
27 Apr. 1965 63 p refs Transl. into ENGLISH from Clin. Med. (USSR), v. 43, no. 1, Jan. 1965 p 11-27, 95-100
(JPRS-29788; TT-65-30834) CFSTI: $3.00

CONTENTS:

1. CONTEMPORARY PROBLEMS OF MEDICAL SCIENCE (XX SESSION OF THE GENERAL MEETING OF THE ACADEMY OF MEDICAL SCIENCES OF THE USSR) V. Kh. Vasilenko and M. A. Zhukovskiy p 1-13

2. DIAGNOSTICS AND CYBERNETICS L. B. Naumov p 14-30 (See N65-22729 12-04)

3. GAS EXCHANGE DURING RADIATION SICKNESS N. A. Kurshakov and S. F. Seberin p 31-52 (See N65-22730 12-04)

4. ON PHYSIOLOGICAL SHIFTS IN THE ORGANISM OF HEALTHY PERSONS IN THE ARCTIC V. A. Popov p 53-59 (See N65-22731 12-04)

N65-22729 Joint Publications Research Service, Washington, D. C.
DIAGNOSTICS AND CYBERNETICS
L. B. Naumov *In its* Recent Develop. in Soviet Med. 27 Apr. 1965 p 14-30 Presented at the Sverdlovsk Soc. of Roentgenol., 9 Feb. 1963 (See N65-22728 12-04) CFSTI: $3.00

Experiments in the practical use of the electronic computer for positive identification of roentgenologically similar diseases of the lungs are discussed. Also, the simplest forms of cybernetic diagnostics when the electronic computer is a component of the man-machine system is considered. Further, the possibility of the use of cybernetics for diagnostically deciphering any recordings, and execution by the electronic computer of unproductive and labor consuming work of the physician, including work fraught with the possibility of particular diagnostic errors is discussed. It is expected that diagnostically used cybernetics will appear most promising where symptomatic information is objectively fixed and not dependent on the skill of the physician. Thus in roentgenological diagnostics, the most expedient use of cybernetics is in pulmonology and osteology. Here the picture itself has complete symptomatic information. The use of the electronic computer in X-ray diagnostics of diseases of the digestive tract is less practical. E.E.B.

N65-22730 Joint Publications Research Service, Washington, D. C.
GAS EXCHANGE DURING RADIATION SICKNESS
N. A. Kurshakov and S. F. Seberin *In its* Recent Develop. in Soviet Med. 27 Apr. 1965 p 31-52 (See N65-22728 12-04) CFSTI: $3.00

Changes in the gas composition of the blood during acute and chronic radiation sickness are discussed. Development of anemia during the acute and chronic course of the disease leads to a decrease of the oxygen reserves of the blood and to anemia hypoxia in the period of acute clinical manifestations. The lowering of the oxygen reserves of the blood is caused not only by the decreased quantity of hemoglobin in the blood but also by the lowered ability of the hemoglobin to combine with oxygen. E.E.B.

N65-22731 Joint Publications Research Service, Washington, D. C.
ON PHYSIOLOGICAL SHIFTS IN THE ORGANISM OF HEALTHY PERSONS IN THE ARCTIC
V. A. Popov *In its* Recent Develop. in Soviet Med. 27 Apr. 1965 p 53-59 (See N65-22728 12-04) CFSTI: $3.00

The deficiency of vitamin C, the functional state of the liver, composition of peripheral blood, and the state of the cardiovascular system for individuals living in the Arctic are discussed. Shifts in the human body are caused by the high stress, hypovitaminosis, and lack of light in the Arctic. From studied functions of the liver, the earliest and most strongly expressed ability of this organ is the adjustment to the colloidal state of the proteins of the blood serum and to pigmentation.

The most essential changes in the peripheral blood are the inclination to leucopenia, eosinopenia, and monocytopenia. Also, low indices of the erythrocyte sedimentation rate were noted. For healthy persons a tendency to hypotonia was four and one-half times more frequent than to the hypertonic state. Further, high instability of pulse and arterial pressure was noted. E.E.B.

N65-22733 Walter Reed Army Inst. of Research, Washington, D. C.

MEDICAL TRENDS IN LIFE SUPPORT SYSTEMS

Timothy G. Barila *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 1–7 (See N65-22732 12-34)

Support of life during stressful situations is discussed. Frequently, death due to cardiac arrest appears premature in the sense that the organ gives little evidence of damage; such deaths can be (and frequently are) reversed by prompt attention. Revival of the heart by electrical impulse, direct massage, or combination of chest pressure and mouth-to-mouth breathing, is an indication that support of life under stress may often be possible. When stress damage is drawn out in time, organ transplant or artificial organs can be the means of affecting reversal of death. Experiments with a small artificial heart pump which was used to provide dogs with a pulsating blood flow for 2 hours suggest that it may be possible to develop miniaturized organ replacements for extended use in victims who might not otherwise be saved. J.M.D.

N65-22747 Army Biological Labs., Fort Detrick, Md.

A MECHANISM OF ACTION OF STAPHYLOCOCCAL ENTEROTOXIN POISONING

Gerald J. Crawley, John N. Black, Irving Gray, and Wayne A. Leblang *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 207–220 refs (See N65-22732 12-34)

The distribution of, and physiological response to staphylococcal enterotoxin was followed in several species of animals. Symptomatology, disappearance times, methods used, and results from blood binding, tissue distribution and body space studies are discussed. Although no information concerning the possible role of the central nervous system in the pathogenesis of acute staphylococcal toxin reactions resulted, the studies suggested the following: (1) The toxin is bound initially to white blood counts (WBC) and albumin. (2) Toxin-bound WBC's are trapped in the lungs. (3) The lungs develop increased weight due to interstitial fluid accumulation which occurs with loss of vascular fluid, but with unchanged total body water, intracellular water, and extracellular fluid. (4) Rechallenged and resistant animals react differently as evidenced by an early increased accumulation of toxin in the liver, and an increased clearance of toxin free of protein by the kidney and thyroid. M.G.J.

N65-22761 Army Biological Labs., Fort Detrick, Md.

THE EFFECT OF HYPERTHERMIA ON PROTEIN TURNOVER IN INFECTION

Irving Gray and Paul V. Hildebrandt *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1965] p 405–411 refs (See N65-22732 12-34)

Protein metabolism has been followed in control, hyperthermia and hyperthermia plus virus. Breakdown is increased in both experimental groups over that in the control group. It is concluded that this increase, caused primarily by the fever, contributed to the previously observed increased nitrogen excretion. Evidence is presented to support the concept that protein synthesis is stimulated by the presence of virus at a time simultaneous with that of the observed protein breakdown. Author

N65-22762 Walter Reed Army Inst. of Research, Washington, D. C.

MOLECULAR MECHANISMS OF ANTIMICROBIAL ACTION

Fred E. Hahn *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 413–426 refs (See N65-22732 12-34)

Antibiotics were found to inhibit (1) cell wall synthesis (penicillin), (2) protein synthesis (chloramphenicol, tetracyclines, streptomycin, erythromycin), (3) RNA synthesis, and (4) DNA synthesis. Mechanisms by which these effects are produced were studied and typical results of this research are reported. Chloramphenicol and erythromycin appear to inhibit protein biosynthesis by direct interaction with ribosomes. In all instances, the antimicrobial actions occurred in the general area of macromolecular biosynthesis and assemblage. Author

N65-22763 Walter Reed Army Inst. of Research, Washington, D. C.

INFLUENCE OF TRAUMA AND HEMOLYSIS ON HEMORRHAGIC SHOCK IN DOGS

Robert M. Hardaway, III *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 427–440 refs (See N65-22732 12-34)

The paper reports results of experiments to assess the role of hemolysis in hemorrhagic shock. A small amount of endogenous hemolyzed blood causes an increase in mortality of dogs in hemorrhagic shock from 13% to 91% due to the stimulation by hemolyzed blood of disseminated intravascular coagulation (DIC), which is also stimulated by hemorrhage and shock. The lethal factor is a clotting factor in the red cell. Hemolyzed blood, harmless alone, is lethal in the presence of shock. Hemolyzed blood causes conversion of fibrinogen to fibrin. Fibrinolysin prevents death in irreversible hemorrhagic shock both as produced by hemorrhage alone and as influenced by hemolyzed blood. Endogenous heparin is stimulated by DIC which is produced either by hemorrhage alone, hemolyzed blood alone, or a combination of both. A prolonged silicone clotting time during hemorrhagic shock prognosticates irreversibility. Irreversibility is correlated with a fibrinogen fall caused by consumption in DIC. Central venous pressure is not elevated even though the shock is irreversible. Irreversibility is due to an episode of DIC. Author

N65-22800# Atomic Energy Commission, New York. Environmental Studies Div.

HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM Quarterly Summary Report, Dec. 1, 1964–Mar. 1, 1965.

Edward P. Hardy, Jr. and Joseph Rivera 1 Apr. 1965 330 p refs

(HASL-158) CFSTI: $4.00

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1. HASL FALLOUT PROGRAM DATA AND DATA FROM OTHER SOURCES p 1–272 refs

2. INTERLABORATORY CALIBRATION PROGRAM—1964 P. W. Krey p 273–277

3. ANALYSES OF INTERLABORATORY COMPARISON SAMPLES, BLIND DUPLICATES AND BLANKS AT HASL AND OTHER LABORATORIES FROM SEPTEMBER 1963–DECEMBER 1964 E. P. Hardy, Jr. p 278–294 refs

4. FALLOUT IN THE ATLANTIC OCEAN H. L. Volchok and M. T. Kleinman p 295–299 refs

5. STATISTICAL VARIATION OF THE EQUIVALENCE OF POT AND ION EXCHANGE COLUMN Sr-90 SAMPLES L. D. Y. Ong and Frances K. Durkan p 300–306

6. DIETARY INTAKES AND BODY BURDENS OF Cs-137 J. Rivera p 306–309 refs

7. THE EARLY STRATOSPHERIC DISTRIBUTION OF DEBRIS FROM A SNAP 9A ABORT L. P. Salter p 310–324 refs (See N65-22801 12-13)

N65-22801 Atomic Energy Commission, New York. Environmental Studies Div.

THE EARLY STRATOSPHERIC DISTRIBUTION OF DEBRIS FROM A SNAP-9A ABORT

L. P. Salter *In its* Health and Safety Lab. Fallout Program 1 Apr. 1965 p 310–324 refs (See N65-22800 12-13) CFSTI: $4.00

Recent measurements of plutonium isotopes by high-altitude balloon program filter papers were used to establish a distribution pattern for the SNAP-9A debris from the burnup of 17 kilocuries of Pu-238 in the upper stratosphere of the Southern Hemisphere. The first debris was found in August 1964 at 108 kilofeet, 34° S latitude, and descended subsequently to 80 kilofeet in January 1965, at which time the material was also detectable in the highest altitudes of the Northern Hemisphere. The concentration profile for SNAP-9A Pu-238 is presented in a table, and a comparison with the Cd-109 production of the high-altitude Starfish Prime plutonium probe of July 9, 1962 is given. In this latter probe Cd-109 was produced and has served as tracer for debris. Quantitative differences between the Pu-238 and the Cd-109 data suggest that the relative concentrations of SNAP-9A debris are about a factor of five greater. These differences are attributed to a lower yield or escape of Cd-109, and to variations in location, season, and stratospheric motion. G.G.

N65-22844# Max-Planck-Institut für Biophysik, Frankfurt am Main (West Germany).

RADIATION EFFECTS ON LIVING TISSUES AND ORGANISMS. SERIES C: BIBLIOGRAPHIES

W. Stahlhofen, comp. AED Information Service, 1965 176 p refs

(AED-C-04-16)

A bibliography of various studies pertaining to the radiation effects on living tissues and organisms for the years 1962 and 1963 is presented. The 540 publications are recorded on IBM punch cards and numbered for easy retrieval so that the research information is readily available to interested research and industrial centers in Germany. G.G.

N65-22877 Joint Publications Research Service, Washington, D. C.

LIMITING FREQUENCIES WITH RESPECT TO ABSORPTION *In its* Optimum Working Freq. in Short-Wave Commun. 19 Apr. 1965 p 2–16 refs (See N65-22875 12-07) CFSTI: $1.00

Calculations on the limitations of short-wave radiofrequencies with respect to absorption are presented for radio tracks of varying latitudes. It was found that the limiting frequency for their transmittal is the least frequency at which radio communications are still possible at the given power of the transmitter over the given distance. Comparison of the calculated values with experimental values from a radio track at midlatitude showed good agreement. The apparent increase of absorption by day and its decrease during nighttime are associated with the ultraviolet radiation of the sun which is at its maximum at noon. Experiments and calculations of the limiting frequencies with respect to absorption for higher latitudes established a nighttime maximum caused by the corpuscular radiation of the sun and a daytime maximum associated with the ultraviolet radiation. Both in mid- and high-latitudes the absorption depends strongly upon the radiation power used for transmission. G.G.

N65-22889# Naval School of Aviation Medicine, Pensacola, Fla.

REVIEW OF MOTION SICKNESS DRUGS FROM 1954–1964 Special Report No. 64-2

Charles D. Wood (Arkansas Univ.) 10 Dec. 1964 16 p refs (AD-611394)

The problem: The great increase in air and sea travel has resulted in a greater need for effective antimotion sickness drugs, and the exploration of space is expected to intensify this need. Since a review of available antimotion sickness drugs has not been published since 1955, a compilation of the newer drugs and studies reported in the last 10 years is presented. Findings: Hyoscine (scopolamine) still appears to be one of our most effective antimotion sickness drugs. Its severe side effects of drowsiness, vertigo, and dry mouth limit its usefulness. Meclizine (bonamine) and cyclizine (marezine) are reported to be the most effective of the antihistamines. Their side effects are milder than most other preparations, and their level of reported effectiveness approaches that of hyoscine. TAB

N65-22946# Indiana Univ., Bloomington.

EFFECTS OF VARIATION IN VISUAL AND AUDITORY STIMULATION ON GASTROINTESTINAL MOTILITY

Robert M. Stern Jan. 1964 12 p refs

(Contract DA-49-193-MD-2063)

(TR-12; AD-610180)

The short-term effects of variation in visual and auditory stimulation on gastrointestinal motility were studied. Two experiments were conducted using male students (Ss) who were exposed to the following conditions: (A) sensory reduction (no visual or auditory stimulation); (B) unrestricted vision and a constant low auditory input; and (C) constant, low auditory input and restricted visual input (unpatterned stimulation). A hypothesis stating that gastrointestinal motility would decrease in all groups during a 40-minute experimental period, but that the group receiving diffuse visual stimulation would show the slowest rate of change, was tested. Gastrointestinal motility, recorded on a specially designed apparatus, was defined in terms of the amplitude component of the recordings, and measured at 1-minute intervals. Results support the hypothesis that gastrointestinal motility recorded from Ss in condition (C) would be greater than that recorded from the other two groups. All three groups showed adaptation over time, group (C) showing the slowest rate of change. Increase in gastrointestinal activity for group (C) is attributed to the novelty and ambiguity of the stimulus situation. S.C.W.

N65-22947# Indiana Univ., Bloomington.

EFFECTS OF CONTRAST IN STIMULATION ON GASTROINTESTINAL MOTILITY

Robert M. Stern Jul. 1964 12 p refs

(Contract DA-49-193-MD-2063)

(TR-14; AD-610181)

The effects of contrasting levels of stimulation on gastrointestinal response was studied. Two groups of male students were subjected to high and low levels of stimulation. It was hypothesized that a change to a moderate level of stimulation would result in a decrease in gastrointestinal motility below baseline level for a group that was responding at a high level to high stimulation, and an increase in level of responding for a group that was responding at a previously low level to low stimulation. The validity of this hypothesis was established. The significance of reversal activity in the gastrointestinal system was also studied. It was further hypothesized that the relative mean amplitude of gastrointestinal motility would reverse if the system reacted in a manner similar to other autonomically innervated systems. It was found that in the gastrointestinal system, any change in stimulation is activating for 2 to 3 minutes regardless of the direction of change, and that it is not until this initial effect of the abrupt change dissipates

that the contrast effect can be seen. In autonomic systems however, there is an immediate reversal in relative level of responding with change in level of stimulation. S.C.W.

N65-22949# Navy Medical Neuropsychiatric Research Unit, San Diego, Calif.
STRUCTURAL CHANGE IN SMALL ISOLATED GROUPS
Paul D. Nelson [1963] 10 p refs
(Rept.-64-24; AD-609543)

Men who had spent 12 months at one of three Antarctic research stations (N ranging from 17 to 33) provided information at two time periods concerning work, formal communication, and off-duty friendship interactions. The purpose was to ascertain the extent to which group structure changed in any of these three domains of interaction over a 6-month period. From an analysis of direct, indirect, and reciprocal choices there were no general change patterns common to all station groups or all types of interaction. Author

N65-22964# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Biologie und Landwirtschaft
THE CHANGING OF PRONOUNCED TECHNOLOGICAL TRAITS OF INDUSTRIAL YEAST DUE TO ^{60}Co RADIATION [VERANDERUNG TECHNOLOGISCHER CHARAKTERISTIKA VON BETRIEBSHEFE DURCH ^{60}Co-BESTRAHLUNG]
K. Prosenz, H. Gaisch, and K. Kaindl [1964] 17 p refs In GERMAN Submitted for Publication
(SGAE-BL-12/1964)

Irradiation of industrial yeast in brewer's wort by a Co^{60} source producing 78 600 rad/h ±225 rad for 0.6 to 1.3 MeV was investigated for its effects on (1) degree of fermentation; (2) pH behavior; (3) CO_2 production; (4) final degree of fermentation; (5) acidity; (6) alcohol production; (7) yeast quantity; (8) fragmentation ability; and (9) residual sugar. All observed parameters showed stimulation at 0.05 Mrad, and inhibition and slowing down at increased radiation dosage. The observed activities at low gamma radiation could be utilized for higher yeast and alcohol production. Transl. by G.G.

N65-22968*# National Aeronautics and Space Administration, Washington, D. C.
BIBLIOGRAPHIC INDEX TO LITERATURE ON AEROSPACE MEDICINE AND BIOASTRONAUTICS PUBLISHED IN THE USSR (1962–1964) [BIBLIOGRAFICHESKIY UKAZATEL' LITERATURY PO AVIAKOSMICHESKOY MEDITSINE I BIOASTRONAVTIKE, IZDANNOY V SSSR (1962–1964)]
L. I. Boreva and E. M. Zavodovskaya, comp. May 1965 69 p refs Transl. into ENGLISH of the paper presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964
(NASA-TT-F-270) CFSTI: HC $3.00/MF $0.75

This bibliographic index includes the basic scientific publications in the areas of space medicine and bioastronautics published in the U.S.S.R. from 1962 to 1964. It encompasses studies in *General Problems of Space Biology and Aerospace Medicine; Experimental Investigations on Spacecraft Satellites, High-Altitude Geophysical Rockets and Aircraft; Results of Laboratory Investigations with Simulation of the Effects of Space Flight Factors; Methodology; Experimental Investigations on Spacecraft Satellites, High-Altitude Geophysical Rockets, Aircraft and in Parachute Jumps;* and *Question of Evaluation, Selection and Preparation of Flight Crews.* G.G.

N65-22984# California Univ., Livermore. Lawrence Radiation Lab.
GAMMA DOSE RATES AND INTEGRATED DOSES FROM NEUTRON-INDUCED RESIDUAL RADIOACTIVITY IN SOIL
R. M. Lessler and F. W. Guy 1 Mar. 1965 54 p refs
(Contract W-7405-ENG-48)
(UCRL-12339, Vol. I) CFSTI: $3.00

Gamma dose rates and integrated doses above the soil resulting from neutron activation of the soil by a nuclear explosion were calculated for various times after burst for several different initial neutron energies, heights of burst, soils, and atmospheric conditions. Methods of calculation are described and results presented. Examples are given of extrapolation of the results to situations not specifically covered in the data. Author

N65-22992# Rochester Univ., N.Y. Div. of Radiology and Biophysics
THE RETENTION OF STRONTIUM-90 BY FETAL AND NEWBORN RATS
B. J. Hopkins, R. C. Baxter, and L. W. Tuttle 29 Mar. 1965 17 p refs
(Contract W-7401-ENG-49)
(UR-661)

The effect of dose size, maternal age at conception, and gestational age at the time of injection upon the retention of strontium in rat fetuses and newborn was investigated. Examination of the offspring from 60 pregnant females of the Long–Evans strain injected with Sr^{90} showed that the fraction of the dose retained by the developing fetus or newborn was not influenced markedly by the size of the dose injected to the dam over the range of 24 to 382 microcuries. When 191 or 382 microcuries was injected to the dam on the second day postconception, 0.05% and 0.04% of the dose was retained, respectively, by the litter on the 20th day postconception. The percentage retained was similar when doses were injected on the tenth day postconception. The percentage retained in the litter at parturition following injection on the 17th day postconception was 3.5%, 4.0% and 3.9% of total doses of 24, 191 or 382 microcuries of strontium-90, respectively. The dose fraction retained by the newborn was greatly influenced by the gestational age at the time of injection to the mother. Author

N65-23002*# Northrop Space Labs., Hawthorne.
INVESTIGATION OF *PEROGNATHUS* AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY
Progress Report, 1 Jan.–31 Mar. 1965
J. J. Gambino and R. G. Lindberg [1965] 30 p refs
(Contract NASw-812)
(NASA-CR-62556; NSL-64-29-6) CFSTI: HC $2.00/MF $0.50

It was proved possible to breed *Perognathus longimembris* in captivity. Yield per unit effort is quite low at the present state of the art; a renewed effort to obtain breeding in litter mates is indicated. That litter mates have been kept together for long periods without mortality suggests their antagonistic behavior patterns may be altered. With new knowledge of how to predict receptivity in females and to produce sexually active males, this may be successful. Author

N65-23037# RAND Corp., Santa Monica, Calif.
FLUID BALANCE AND ELECTROLYTE DISTRIBUTION IN THE HUMAN BODY
Edward DeLand and Gilbert B. Bradham Feb. 1965 121 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4347-PR; AD-611818)

A conceptual model and a mathematical method for computing the physiological fluid and electrolyte distribution for selected body compartments of an average, young, 70-kilogram human male are presented. The mathematical procedure simulates the physiological subsystems by incorporating all the known chemical reactions and electrochemical relations which seem necessary to establish the fluid and electrolyte distribution. The construction of the model and the mathematical background is given in heuristic form only. However, considerable detail is shown regarding the analysis of the computed results for a standard, steady-state, average, young, resting, 70-kg human male. Finally, the results of validation experiments, consisting of chemical stresses applied to the model, are discussed. The results of these experiments indicate that the model is a valid supplementary tool for research in the clinical and the research laboratory as well as in theoretical physiology. Author

N65-23062# Joint Publications Research Service, Washington, D. C.

REPARATIVE REGENERATION OF TISSUE UNDER THE EFFECT OF IONIZING RADIATION

V. P. Mikhaylov 4 May 1965 23 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Leningrad), v. 48, no. 2, Feb. 1965 p 3–16
(JPRS-29904; TT-65-30894) CFSTI: $1.00

Reparative regeneration of various tissues of white mice and rabbits following single whole-body X-radiation and single local irradiation was investigated. The regenerative process (developing at the peak of acute radiation sickness) proceeded in irradiated animals as it did in the controls. However, in the irradiated animals there was a higher incidence and extent of hemorrhaging and a weaker inflammatory response. In some animals bacterial colonies were detected on the surface, in the depth of the wound, and in the underlying tissue. It was agreed that inhibition of reparative regeneration of tissues in acute radiation disease (where this does occur) was not directly due to weakening of the proliferative capacity of a given tissue caused by ionizing radiation, but rather to functional disruptions of the whole organism and related complications. R.W.H.

N65-23063# Joint Publications Research Service, Washington, D. C.

SPACE MEDICINE RESEARCH DURING THE FLIGHT OF THE "VOSKHOD"

A. V. Lebedinskiy and Yu. G. Nefedov 4 May 1965 8 p Transl. into ENGLISH from Zdorov'ye (Moscow), no. 1, Jan. 1965 p 7–8
(JPRS-29911, TT-65-30900) CFSTI: $1.00

Because a physician, B. B. Yegorov, was included in the three-man Voskhod flight, instrument methods of medical research were combined with actual observation of the condition of the cosmonauts. The flight demonstrated that older men who had undergone shorter training periods could perform satisfactorily during spaceflight. The medical problems associated with radiation and weightlessness are reviewed generally. This Voskhod flight is considered a beginning step in studying the complex factors involved in biological compatibility of space crew members. M.P.G.

N65-23105# Rochester Univ., N. Y. Medical Div.

CHANGES IN KINETICS OF ERYTHROPOIESIS AS REFLECTED IN FREQUENCY DISTRIBUTION OF ERYTHROCYTE VOLUMES OF ACUTELY BLED DOGS

G. F. Orthey and M. Ingram 22 Mar. 1965 37 p refs
(Contract W-7401-ENG-49)
(UR-662)

A study of the frequency distribution of erythrocyte volumes in normal and acutely bled dogs is described. Cell volumes were measured and graphed with a model B Coulter counter with size distribution plotter. Size distribution of erythrocytes of different ages were evaluated by obtaining frequency distribution graphs (histograms) for various fractions of a centrifuged column of red cells. The normal dog is shown to have a bimodal distribution of erythrocyte volumes, and the cell volume distribution curves of both newly formed and old erythrocytes are virtually identical. The dogs that were studied responded to acute blood loss by producing abnormally sized erythrocytes as well as by marked acceleration of red blood corpuscle (rbc) production. Data are presented to show that the two populations of rbc normally present may vary independently in response to erythropoietic stress. The observations reported are interpreted in light of Lajtha's model for erythropoiesis. Author

N65-23144# Joint Publications Research Service, Washington, D. C.

ON THE ESSENCE OF LIFE

G. M. Frank et al 3 May 1965 360 p refs Transl. into ENGLISH of a book "O Sushchnosti Zhizni" Moscow, "Nauka" Publishing House, 1964 p 1–351
(JPRS-29864; TT-65-30878) CFSTI: $7.00

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2. SPECIFICITY OF BIOLOGICAL METABOLISM V. A. Engelgardt p 31–43
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21. THE ESSENCE OF LIFE AND CERTAIN PROBLEMS OF INDIVIDUAL DEVELOPMENT AND HEREDITY B. L. Astaurov p 270–277

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26. METHODOLOGY FOR DEFINING THE ESSENCE OF LIFE V. I. Kremyanskiy p 342–357

N65-23145# Joint Publications Research Service, Washington, D. C.

STUDIES ON THE TOXICITY OF AEROSOL AND ALIPHATIC AMINES ON INDUSTRIAL PREMISES

4 May 1965 21 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniya (Moscow), no. 12, 1964 21 p
(JPRS-29913; TT-65-30902) CFSTI: $1.00

CONTENTS:

1. TOXICITY OF ALIPHATIC AMINES AND ITS CHANGES IN HOMOLOGIC SERIES A. O. Loyt and V. A. Filov p 1–9 refs

2. TOXICOLOGICAL CHARACTERISTICS OF AEROSOL OF PETROLEUM OILS V. A. Lutov p 10–18 refs

N65-23171*# AiResearch Mfg. Co., Los Angeles, Calif.

STUDY OF THE THERMAL PROCESSES FOR MAN-IN-SPACE

W. L. Burriss Washington, NASA, Apr. 1965 245 p refs (Contract NASw-1015)
(NASA-CR-216) CFSTI: HC $6.00/MF $1.50

Thermal control of the human body is analyzed for the environments obtained in spacecraft shirt-sleeve cabins and extravehicular pressure suits to provide environmental design criteria applicable to extraterrestrial missions. Basic heat and mass transfer correlations are used to establish dependence of the thermal processes and comfort criteria on atmospheric pressure and composition, gravity, ventilating velocity, gas temperature, humidity, and mean radiant temperature. The thermal and comfort criteria are analyzed for the lunar and zero-gravity shirt-sleeve cabins. Extravehicular suit thermal control methods employing ventilation cooling, liquid-loop cooling, and radiation cooling are analyzed to determine the relative performance, limitations, and problems associated with various methods of extravehicular suit thermal control. Extravehicular suit heat balances are performed for earth orbital, lunar orbital, Mars orbital, lunar plane, and lunar crater environments. Author

N65-23230 Brookhaven National Lab., Upton, N. Y.

THE GASES OF THE BLOOD

Donald D. Van Slyke 18 Nov. 1964 22 p refs *Its* Lecture Ser. no. 41 Sponsored by AEC
(BNL-898) CFSTI: $1.00

A brief review of the blood gases and their role in physiology and medicine is given as a historical sequence, and the contributions of some scientists whose studies were elementary in blood gas research and technology are described. Emphasis is placed on oxygen, carbon dioxide, and nitrogen content in the human blood. The importance of variations in oxygen pressure for the oxygenation of hemoglobin, the effects of CO_2 content in the atmosphere, the influence of acids on the oxygen content of hemoglobin, the oxygen saturation in blood, the use of oxygen chambers and tents in the treatment of patients, the use of hyperbaric oxygen to increase the X-ray efficiency in cancer treatments, are among the subjects presented. G.G.

N65-23301# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

INFLUENCE OF THE CARBOHYDRATES ON THE ABSORPTION OF $C^{14}O_3HNa$ THROUGH *CHLORELLA VULGARIS* IN LIGHT AND DARK [INFLUENCIA DE LOS HIDRATOS DE CARBONO EN LA ABSORCION DE $C^{14}O_3HNa$ POR LA *CHLORELLA VULGARIS* EN LA LUZ Y EN LA OSCURIDAD]

Leopoldo J. Anghileri 1965 12 p refs In SPANISH
(Rept.-135)

In a photosynthesis study, *Chlorella Vulgaris* was cultured to determine the influence of carbohydrates on the assimilation of $C_{14}O_3HNA$ under light and dark conditions. The pH level dropped in all cultures especially in the dark-exposed ones. This indicates a deviation in cellular metabolism due to the discontinued photosynthetic process. Carbohydrates were found to increase Chlorella's absorption of C_{14} in all cases but to a lesser degree in darkness. The concentration of the aspartic–glutamic acid group in the cellular protein was notably greater in the dark grown cultures. R.N.A.

N65-23306# Instituto Superiore di Sanita, Rome (Italy). Lab. di Fisica

A CHROMATOGRAPHIC STUDY OF DNA OF *B. STEAROTHERMOPHILUS* [STUDIO CROMATOGRAFICO DEL DNA DEL *B. STEAROTHERMOPHILUS*]

E. Dore 22 Dec. 1964 29 p refs In ITALIAN; ENGLISH summary
(ISS-64/48)

The chromatographic study performed on preparation of denatured DNA from *B. stearothermophilus* and on mixtures containing denatured DNA and RNA from the same microorganism, has led to the isolation of a homogeneous DNA fraction which is unable to reform double stranded structures under annealing conditions. This material corresponds to one of the two strands of native DNA and more precisely to that strand which does not interact with RNA in the formation, at room temperature, of a peculiar type of hybrid DNA–RNA molecule, as revealed by experiments performed at the analytical ultracentrifuge, in CsCl density gradients. The technical details of the chromatographic procedure are given, and the experiments which lead to the identification of the components separated chromatographically are described. Author

N65-23307# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
PREPARATION OF LABELING COMPOUNDS USING ^{131}I AT THE C.N.E.A. OF THE REPUBLIC OF ARGENTINA [PREPARACION DE COMPUESTOS MARCADOS CON ^{131}I EN LA C.N.E.A. DE LA REPUBLICA ARGENTINA]
A. E. A. Mitta and L. L. Camin 1964 13 p refs In SPANISH (Rept.-143)

A description is given of the various methods for preparing labelled compounds with the radioisotope iodine 131. A brief mention is made of their applications in the study of metabolic processes. Transl. by R.N.A.

N65-23321# Joint Publications Research Service, Washington, D. C.
DEVELOPMENT OF LIFE IN THE UNIVERSE
A. G. Masevich 14 Apr. 1965 110 p refs Transl. into ENGLISH of the book "Vozniknoveniye Zhizni Vo Vselennoy" Moscow, 1964 110 p
(JPRS-29591; TT-65-30737) CFSTI: $4.00

CONTENTS:

1. PRESENT-DAY DATA ON THE WAYS OF DEVELOPMENT OF LIFE A. I. Oparin p 2–21 refs
2. THERMAL HISTORY OF THE EARTH V. I. Baranov p 22–42 refs
3. CHEMICAL EVOLUTION OF EARLY ORGANIC COMPOUNDS ON THE EARTH G. P. Vdovykin p 43–48 refs
4. CARBONACEOUS METEORITES L. G. Kvasha p 49–63 refs
5. RECENT DATA ON PHYSICAL CONDITIONS ON PLANETS OF THE EARTH TYPE D. Ya. Martynov p 64–89 refs
6. UNITY AND INTERRELATIONSHIP OF A GALACTIC SYSTEM AS A CONDITION FOR DEVELOPMENT OF LIFE ON PLANETS V. G. Fesenkov p 90–108 refs
7. CONDITIONS FOR DEVELOPMENT OF LIFE IN THE UNIVERSE A. I. Oparin and V. G. Fesenkov p 109–112

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-22252# Rome Air Development Center, Griffiss AFB, N. Y.
THE INTENSITY-TIME RELATIONSHIP FOR FORM IDENTIFICATION
Richard C. Sturtevant Feb. 1965 18 p refs
(RADC-TR-65-16; AD-613557)

The purpose of this experiment was to determine the effect of exposure time and intensity on a form identification response such as might be encountered in a military Command and Control display situation. A conventional psychophysical method was used to determine the applicability of the Bunsen–Roscoe Law (Intensity × Time = a Constant up to a critical duration; and Intensity = a Constant above a critical duration). Exposure time thresholds were found for three subjects for each of five geometric forms at each of five intensities ranging in value from 0.005 to 1 foot-lambert. It was found that the Bunsen–Roscoe Law did not hold, but that time was a more important factor than intensity in identifying the forms. The results are discussed in terms of detection vs. identification of stimuli, and implications for Command and Control display requirements are pointed out. Author

N65-22296 Aberdeen Proving Ground, Md. Army Human Engineering Labs.
A DESIGN FOR ANIMAL-HEARING RESEARCH
John J. Romba *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 275–279 refs (See N65-22275 12-34)

The relative stability of hearing sensitivity of individual subjects over a period of time, and orderly changes of sensitivity occurring when each animal was subjected to various experimental conditions were noted. Patterns appeared which could be recognized as belonging to a particular animal. Characteristic hearing patterns found in individual subjects under normal environmental conditions and the patterns which result from exposure to stress or stimuli are described. A characteristic feature found in individual threshold curves of most subhuman primates is the sharp tonal dip in sensitivity which occurs at about 4000 cps. Another pattern of importance is the amount of individual variability. Also some animals show patterns of variability which differ for different parts of the sensitivity curve. Two animals studied displayed a systematic reduction in the amount of initial shift as a function of increasing number of exposures. It appeared that the auditory mechanism became more and more resistant to the damaging effects of the loud noises. Variables which are important factors in hearing research are subjects, noise exposure, test methods, and data handling. E.E.B.

N65-22425# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF CONTEMPORARY BIOLOGICAL TELEMETRY
V. V. Parin and R. M. Bayevskiy 18 Feb. 1965 22 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 8, 1964 p 924–933
(FTD-MT-64-416; AD-612376)

Biotelemetric systems, based on the application of a radio link for communication between the source of information and the recording instrument, are considered. Emphasis is placed on dynamic biotelemetry, where the transmitter is positioned on the investigated subject thereby allowing the recording of biological data during movement and activity. Endoradio probes include implanted transmitter systems which receive their power supply by autonomous feed, inductive feed, external feed, and passive radiators with feed from biological sources of energy. The method of control of the transmitting device is the criterion that determines its structure and design features. It is assumed that telemetric systems with biocontrol will be feasible in space medicine. Construction and schematic resolutions of biotelemetric systems depend mainly on their purpose and area of application. G.G.

N65-22447# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF RESCUING CREWS AT EMERGENCIES AT GREATER SPEEDS AND HIGH FLIGHT ALTITUDES
A. V. Chesalov 1 Apr. 1965 18 p Transl. into ENGLISH from Tekhn. Vozdushnogo Flota (USSR), 1964, no. 10 p 7–12
(FTD-TT-65-260/1+2; AD-613481)

General philosophy on the value of scientific leadership in the military is presented. TAB

N65-22466# Tufts Univ., Medford, Mass.
PROCEDURAL CONSTRAINT AND TASK PERFORMANCE
Thornton B. Roby and Susan Goldberg Bedford, Mass., AFSC, Electron. Systems Div., Nov. 1964 47 p ref
(Contract AF 19(628)-2450)
(ESD-TR-64-663; AD-613532)

Persons or groups assigned to certain tasks are typically required to follow institutionally originated rules of action or constraints that limit the range of their task behavior. Ordinarily these procedural rules are based on general experience with the task situation and are designed to guard against serious errors; however they have the secondary effect of reducing the potential for superior enterprise or discretion on the part of the performing agent. The question or practical importance concerns the specific conditions that militate in favor of either increased or decreased superordinate control. The present investigation develops a laboratory methodology for studying this problem. The general task condition used was an abstract maze in which subjects had to select a path between designated points. An attempt was made to produce experimental analogs of visibility, or task information accessible to the subject, and environmental bias, or general favorability for exploratory behavior. Three formal studies are reported, and these indicate the relevance of the experimental factors; but the results are too inconsistent across studies to be definitive. Based on these results, certain modifications are suggested for future research. Author

N65-22475# Air Force Systems Command, Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
PREDECISIONAL PROCESSES IN DECISION MAKING: PROCEEDINGS OF A SYMPOSIUM
Darwin P. Hunt, ed. et al Dec. 1964 207 p refs Symp. held at Wright-Patterson AFB, Ohio, Apr. 1962
(AMRL-TDR-64-77; AD-613180)

Predecisional processes may be characterized as the search for, the acquisition of, and the evaluation of information prior to the choice of a course of action. The objectives were an assessment of the adequacy of present decision theories in dealing with human decision making behavior; an assessment of other approaches to decision making situations; and an analysis of predecisional processes. Seven papers are presented that analyze this area from several different theoretical viewpoints. Transcripts of the discussions are also included. Author

N65-22477# Radio Corp. of America, Princeton, N. J. RCA Labs.
ANALYSIS OF MARKOV CHAIN MODELS OF ADAPTIVE PROCESSES Final Report, May 1963–May 1964
K. R. Kaplan and J. Sklansky Wright-Patterson AFB, Ohio, AMRL, Jan. 1965 111 p refs
(Contract AF 33(657)-11336)
(AMRL-TR-65-3; AD-613075)

Learning and adaptation are considered to be stochastic in nature by most modern psychologists and by many engineers. Markov chains are among the simplest and best understood models of stochastic processes and, in recent years, have frequently found application as models of adaptive processes. A number of new techniques are developed for the analysis of synchronous and asynchronous Markov chains, with emphasis on the problems encountered in the use of these chains as models of adaptive processes. Signal flow analysis yields simplified computations of asymptotic success probabilities, delay times, and other indices of performance. The techniques are illustrated by several examples of adaptive processes. These examples yield further insight into the relations between adaptation and feedback. Author

N65-22496# Naval Ordnance Lab., White Oak, Md.
PROPOSAL FOR AN ANALOG COCHLEA
F. E. Warnock Mar. 1965 49 p refs
(NOLTR-64-191; AD-611778)

Using Bionic's precept that nature can suggest better solutions to engineering problems, an electrical ear model was designed for analyzing and classifying complex audio sounds. This lumped constant simulation approximates the transfer of sound energy to a mechanical displacement of the basiar membrance, which is within the inner ear or cochlea. Essentially, this model is a hardware adaption of the model proposed by James L. Flanagan of Bell Laboratories. The model consists of an electrical middle ear simulation, followed by an "artificial" cochlea. This cochlea consists of a special 201 tap delay line whose taps drive cochlea filters. These cochlea filters drive output amplifiers which have been designed to compensate for losses and drive artificial neurons used for processing the parallel outputs. For building this specific hardware model, the component values, tolerances, and specifications are included, along with considerations on signal level, dynamic range, noise, and power consumption. Author

N65-22678# Texas Technological Coll., Lubbock. School of Engineering
INVESTIGATION INTO THE EFFECT OF INTERMITTENT NOISE OF CONSTANT PERIODICITY VS. RANDOM PERIODICITY ON THE PERFORMANCE OF AN INDUSTRIAL TASK
Nevin E. Fornwalt (M.S. Thesis) May 1965 120 p refs
(Contract AF 33(608)-1119)
(AD-611788)

An investigation of the effect of noise of varying periodicity of presentation on the performance of a task involving a sensorimotor factor and a simple-decision factor was performed. The following conclusions regarding this experiment were made: The trial's main effect was significant in the analyses of all dependent variables, indicating that a considerable amount of learning took place over the duration of the experimental testing. The main effect of sex was significant in all analyses except that of wrong switches. The effect of noise periodicity of the performance of the experimental task was significant in the analysis of wrong switches. Interactions involving noise type indicated that the random noise produced greater deleterious effects on performance than periodic noise, and that both types of intermittent noise had greater adverse effects on performance than continuous noise. Noise intensity did not have a significant main effect in any of the analyses. The 70-dB intensity generally produced the most deleterious effects in males; whereas, the 82-dB intensity had this effect on females. Findings regarding age indicated that the younger age group's latencies were predominantly in the late category; whereas those of the older group were evenly divided between the early and late categories. TAB

N65-22723 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF MOVEMENT COORDINATION WHEN WRITING UNDER CONDITIONS OF SPACE FLIGHT
A. I. Mantsvetova, I. P. Neumyvakin, V. F. Orlova, V. A. Trubnikova, and I. M. Freydberg *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 228–255 refs (See N65-22713 12-30)

This article discusses results from investigations of the coordination of movement in writing, on the basis of astronauts' entries in the logs of space vehicles. The materials of the cited investigations made it possible to note changes in the coordination of movements throughout the course of a space

flight. The coordination of movements was characterized by variations in handwriting, reflecting specific features of movement during writing, as well as by the changes which occurred under the influence of the various external and internal conditions under which the subject texts were being prepared.
Author

N65-22808# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences
A PROBABILISTIC MODEL FOR FREE-RESPONDING Technical Report No. 67
M. Frank Norman (Ph.D. Thesis) 14 Dec. 1964 100 p refs
(Grant AF-AFOSR-62-384)
(AFOSR-65-0288; AD-611163)

An animal behavior model is presented which describes time between responses in situations where response can be repeated at will. Examples of such situations involve rats or pigeons in a cage with a lever apparatus which (when triggered) produces a food reward for the animal. Mathematical properties of the model are investigated, and an asymptotic form of the probability distribution of interresponse time is derived. The model is applied to experimental data for comparison of observed and predicted mean interresponse times. It is established that interresponse time densities need not decrease monotonically with increasing length of interresponse time.
J.M.D.

N65-22869# Autonetics, Anaheim, Calif. Human Factors Dept.
LABORATORY STUDIES IN AIR-TO-GROUND TARGET RECOGNITION. II: THE EFFECT OF TV CAMERA FIELD OF VIEW
G. Rusis and H. L. Snyder 4 Mar. 1965 31 p refs
(T5-133/3111)

A laboratory simulation experiment was performed to determine the effect of the TV camera lens field of view upon air-to-ground target recognition by closed-circuit television. Measures of performance were probability of correct target recognition, range of correct recognition, and numbers of errors committed. It was found that, as the field of view decreased, probability of correct recognition decreased, range of correct recognition increased, incorrect target recognitions did not vary, and number of no-response targets increased. The results were discussed in terms of their applicability to tactical airborne situations.
Author

N65-22870# Autonetics, Anaheim, Calif. Human Factors Research
LABORATORY STUDIES IN AIR-TO-GROUND TARGET RECOGNITION. III: THE EFFECTS OF AIRCRAFT SPEED AND TIME-TO-GO INFORMATION
G. Rusis and R. L. Calhoun 10 Mar. 1965 28 p refs
(T5-134/3111)

An experiment was performed to assess the effects of time-to-go information and aircraft speed upon probability of correct target recognition, range of correct recognition, and errors committed. The ground speeds simulated were 198 and 792 knots. Time-to-go information, when provided, was in the form of a verbal tape recorded time countdown to the target. Performance was better at low than at high speeds. Providing the subjects with time-to-go information resulted in an increased probability of target recognition and in a decreased number of no-response targets; it had no effect upon range of recognition or percent of incorrect recognition.
Author

N65-23007# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
MAN AND MISSION SUCCESS
D. Amorelli, B. G. Peters, and J. T. Celentano 7 Feb. 1964 34 p refs Presented at 1964 SAE-ASME-AIAA-Aerospace Reliability and Maintainability Conf., Washington, D. C., 29 Jun.–1 Jul. 1964
(Rept.-546-M; AD-457785)

This paper discusses a concept of reliability, which includes the relationship of man to total system reliability, and the techniques and controls used to insure spacecraft mission success through reliability. Former maintainability concepts for weapon systems are reviewed. Their inadequacies for manned spacecraft are indicated. The reliability concepts for manned spacecraft, which require that all systems function during a mission, are examined. Examples of man's contribution to the reliability of aircraft and spacecraft systems are discussed. These concepts will permit achievement of mission success that approaches 100%, using hardware with a reliability of 80%. The method for integrating reliability concepts, step by step, into design analysis and review is discussed as is the subsequent extension into test and redesign activities. The method for integrating man into the space system reveals his ability to manually override, maintain, and repair. This upgrades reliability and provides the means to assure mission success.
Author

N65-23082# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
AN EVALUATION OF PROPOSED APPLICATIONS OF REMOTE HANDLING IN SPACE
Gerald P. Chubb Oct. 1964 16 p refs Presented at the Symp. on Remotely Operated Spec. Equipment (Proj. Rose) AEC, Germantown, Md., 26–27 May 1964
(AMRL-TR-64-98; AD-608802)

This report discusses problems of applying remote handling techniques to assembly and maintenance operations in space. Some of the methodological problems are pointed out and current conceptions of remote handling in space are evaluated. Areas where more research is required are pointed out. Remote handling systems based on the state of the art are feasible, but may not be adequate for all proposed tasks, and certainly not all are optimal or efficient.
Author

N65-23083# Rome Air Development Center, Griffiss AFB, N. Y.
PHOTOINTERPRETER PERFORMANCE STUDIES
Shelton Mac Leod Sep. 1964 61 p refs
(RADC-TDR-64-326; AD-609071)

This report is a summary of five studies designed to explore important relationships between measures of photointerpreter performance and the following types of antecedent factors: (1) image quality; (2) mode of presenting comparative-cover photography; (3) techniques for rapid recognition training; (4) temporal aspects (viewing time and work–rest cycles) of image presentation; and (5) image content parameters. Each study is reviewed with respect to experimental objectives, approaches, results and conclusions. Immediate applications of the data and implications for future research are also discussed.
Author

N65-23085# Bell Aerosystems Co., Buffalo, N. Y.
PRELIMINARY INVESTIGATION OF TRAINING REQUIREMENTS FOR AIR CUSHION VEHICLE (ACV) OPERATORS

R. Flexman and G. S. Malecki Port Washington, N. Y., Naval Training Device Center, Aug. 1964 146 p refs
(Contract N61339-1557)
(NAVTRADEVCEN; AD-609364)

The operator training requirements for air cushion vehicles were investigated, with the various subsystem functions and operations of the respective design configurations considered. It was felt that the existence of many common vehicle characteristics permits useful predictions of operator task requirements, training equipment needs, and the definition of areas of further analysis and applied research. The following study areas are discussed: *Description of Air Cushion Vehicles; Identification of ACV Applications; Description of ACV Controls and Displays; Identification of Natural and Induced Environmental Factors; Operator Task Description for Bell SK-3 Caraboa and U.S. Navy Hydroskimmer; Description of Handling Characteristics and Techniques for U.S. Navy Hydroskimmer; Estimation of Skill and Training Requirements;* and *Recommendations for Further Research.* G.G.

N65-23152# Lockheed-California Co., Burbank. Rye Canyon Research Center
INSTRUMENTATION TECHNIQUES FOR ANALYSIS OF CHARACTERISTICS OF ANIMAL SONAR PULSES
John J. Dreher, William W. Sutherland, and William E. Evans 14 Jan. 1965 49 p ref
(Contract Nonr-3680(00))
(LR-18525; AD-610880)

The following conclusions are offered: (1) The demonstrated effects of inhomogeneities of the transmission medium on airborne pulses, analogous to the inhomogeneities of sea water, probably relegate the active sonar signature of a water immersed target to a statistical description, i.e., single-pulse returns will evidence variations that must be detected by multiple samples. (2) The survival history and recently demonstrated target performance of several marine mammals strongly indicates their use of rapidly repeated pulses to utilize a "pulse phoneme" principle. (3) The observable and measurable differences in some physical parameters of marine mammal sonar pulses suggest functional specificity related in some fashion to the biological needs and capabilities of a particular genus. (4) Zalophus appears to produce pulses of much narrower bandwidth than do cetacea. (5) The use of certain analysis methods outlined above may reveal classification techniques for relating functional behavior of cetacea on the basis of their echo-location mechanisms. TAB

N65-23166*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EVALUATION OF PILOT'S ABILITY TO STABILIZE A FLEXIBLE LAUNCH VEHICLE DURING FIRST-STAGE BOOST
Gordon H. Hardy, James V. West, and Robert W. Gunderson Washington, NASA, May 1965 61 p refs
(NASA-TN-D-2807) CFSTI: HC $3.00/MF $0.75

Feasibility of manned participation in the control of the atmospheric flight of a large launch vehicle was investigated. Studies included simulation of rigid, elastic, and fuel-sloshing dynamics of the Saturn V lunar mission vehicle. Fixed cockpit and centrifuge results indicate that pilots could satisfactorily stabilize the vehicle and reduce structural loads. They were also able to handle wide variations in vehicle parameters and to handle certain failure situations. Author

N65-23170*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ATTENTION IN TIME DISCRIMINATION AND REACTION TIME
Alfred B. Kristofferson Washington, NASA, Apr. 1965 141 p refs
(Contract NAS2-1790)
(NASA-CR-194) CFSTI: HC $4.00/MF $1.00

A theory of attention is developed which emphasizes its temporal features. Attention is considered as a central-neural control of information flow accomplished within the central nervous system. That it is all-or-none in nature is hypothesized. The theory is framed and experiments are done in a sensory context. Of two methods for measuring the theoretical parameters, one involves the human ability to discriminate two independent sensory events as successive rather than simultaneous, and the other concerns the influence of channel uncertainty upon reaction time. Results of experiments to measure the theoretical parameters in these two ways are given: (1) The same signal may or may not be processed by attention, depending upon use made of its information. Channel uncertainty does not affect detection-reaction times, but does affect discrimination-reaction times. (2) Practice is an important variable. After extensive practice, attention is irrelevant to detection-reaction, but not to discrimination-reaction, time. (3) The four-signal, discrimination-reaction-time procedure cannot be used to estimate parameters for single individuals because of intra-individual variability. Author

N65-23283*# Maryland Univ., College Park. Dept. of Psychology
BEHAVIORAL RESEARCH AND EXPERIMENTAL ANALYSIS OF COMPLEX BEHAVIORAL REPERTOIRES UNDER FULL ENVIRONMENTAL CONTROL Semiannual Status Report, 1 Oct. 1961–31 Mar. 1962
Joseph V. Brady and Jack D. Findley [1962] 15 p refs
(Grant NsG-189-61)
(NASA-CR-62606) CFSTI: HC $1.00/MF $0.50

The general problem areas of investigation are outlined and several examples of specific experiments are given. The problem areas discussed are (1) basic research on the integration of complex behavioral repertoires as they relate to space flight problems; (2) development of better procedures for maintaining large and continuously effective behavioral outputs; (3) development of repertoire components relevant to space flight problems involving timing, counting, information processing, and decision making; (4) refinement of techniques for controlling and assessing changes in sensory and motor functioning; and (5) design of long term behavioral environments for overcoming problems of reliability, isolation, and confinement. E.E.B.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-22226# Cincinnati Univ., Ohio.
THE ENERGETICS OF THE COMBINATION OF A PROTON AND HYDRIDE ION Final Report, Sep. 1, 1963–Sep. 30, 1964
Raymond E. Dessy [1964] 12 p refs
(Grant AF-AFOSR-417-63)
(AFOSR-65-0245; AD-611152)

The rate of addition of the "bumgbr" grignard reagent to benzonitrile was found to be greatly accelerated by the addition of $LiClO_4$ or $(C_4H_9)4NClO_4$. An investigation of the reaction mechanism leads to the suggestion that the phenomena represent an example of the activation of organometallic compounds by the presence of "inert salts". Studies in the area of carbanion stabilities are briefly summarized. Author

N65-22239# Kent State Univ., Ohio. Dept. of Chemistry
A NEW APPROACH TO MEASUREMENT OF DIPOLE MOMENT AND ELECTROLYTES IN PURE ACETIC ACID Final Report, Apr. 1959–Dec. 1964
R. Thomas Myers [1964] 9 p refs
(Contract AF 49(638)-641)
(AFOSR-65-0366; AD-612040)

In the method introduced here interpolations, rather than extrapolations, are used, and the value obtained in solution for dipole moment is apparently the same as that in the gas phase, within the experimental error of measurements of the latter. The chief reason for inability to make a definite statement here is the discordant data for dipole moments. TAB

N65-22255# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
KINETICS OF CONDENSATION FROM THE VAPOR PHASE Quarterly Report, Nov. 1964–Jan. 1965
Welby G. Courtney Feb. 1965 5 p
(Contract Nonr-4154(00))
(RMD-5515; AD-611847)

The theoretical problems involved in nucleation are being reexamined. Theoretical computation of cluster energy using a simple molecular-pair model is being explored. The problem is to predict the thermodynamic equilibrium concentration of such clusters. This equilibrium concentration of a certain-sized cluster is related to the free energy of the cluster. The free energy of the cluster in turn involves its translation and rotation energies and also the vibration energy of the cluster. The manuscript titled "Re-Examination of Nucleation and Condensation of Water" is being revised, and a computer is being used to evaluate the energies of various-sized argon clusters. TAB

N65-22256# Kansas Univ., Lawrence. Dept. of Chemistry
LOW TEMPERATURE VOLTAMMETRY AND ELECTRON PARAMAGNETIC RESONANCE STUDIES Final Report
Ralph N. Adams [1964] 6 p refs
(Grant AF-AFOSR-62-14)
(AFOSR-65-0340; AD-611806)

A brief summary is given of EPR investigations involving radical ion intermediates in various electrode reactions. A bibliography of publications generated under the contract is included. TAB

N65-22280 Army Materials Research Agency, Watertown, Mass.
THE MAXIMUM DISSOCIATION ENERGIES OF DIATOMIC MOLECULES OF TRANSITION ELEMENTS. PART I: UPPER LIMITS FOR TITANIUM, CHROMIUM, AND MANGANESE
Arthur Kant and Bernard Strauss *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 55–66 refs (See N65-22275 12-34)

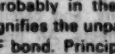
An attempt is made to identify the dimers of the transition elements and to estimate their bond energies by using a combination of Knudsen equilibrium techniques with mass spectrometric analysis at high temperatures. The results for titanium, chromium, and manganese are presented. Although no diatomic molecules of these elements have been found, from the limits of detectability of the instrumentation and statistical thermodynamics it was possible to establish their maximum dissociation energies. The measurements were obtained with a time-of-flight mass spectrometer. A model of binding energy which qualitatively explains the limited results thus far obtained for the dissociation energies of the transition elements is also presented. If the model proposed is correct, copper, iron, and vanadium should have rather low dissociation energies and thus dimers will be found only at temperatures substantially higher than used in the present work. E.E.B.

N65-22285 Army Natick Labs., Mass.
MOLECULAR STRUCTURE AND PROTEIN STABILITY: THE ACID DENATURATION OF α LACTALBUMIN
Martin J. Kronman, Robert Blum, Raymond Andreotti, Rasma Vitols, and Leo Holmes *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 121–135 refs (See N65-22275 12-34)

Investigations were conducted to determine what molecular features convey stability to a protein. The protein molecule was disrupted partially and an attempt made to describe what molecular events occurred during the process, i.e., which kind of bonds were broken and which remained intact. The protein, alpha lactalbumin, a constituent of milk whey which has a molecular weight of 16.2×10^3 was chosen for the investigation. One of the more unusual characteristics of this protein is its extraordinary resistance to thermal denaturation. Changes in the molecular shape of the protein with change in hydrogen ion concentration were noted by comparison of the sedimentation properties of the molecule at pH 2 and at pH 8.55. Also, differential ultraviolet spectra revealed that at pH 8.55 a nearly spherical shape with a radius of about 19 Å and at pH 2 the frictional ratio increased to a value corresponding to an elongation of the molecule to yield a more ellipsoidal shape with a radius of about 23 Å. Rotatory dispersion measurements were also made on the protein. Results and discussion of the molecular changes are included. E.E.B.

N65-22289 Army Research Office, Durham, N. C.
FLUORINE HYPERFINE INTERACTION IN ELECTRON SPIN RESONANCE
Robert Lontz *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 185–196 refs (See N65-22275 12-34)

The electron spin resonance of irradiated single crystals of trifluoroacetamide was studied. The source for the irradiation was the 1.3-MeV gamma rays of Co^{60}. The dosage had no observable effect on the type of free radical formed and exposures lasted several hours or more. The normally colorless crystals turned yellow upon irradiation. Analysis of the spectra showed that one of the CF bonds was broken as a result of the irradiation. The remaining two CF bonds become reoriented so that the



group is planar and very probably in the plane of the CON group. The dot over the C signifies the unpaired electron resulting from breakage of the CF bond. Principal values and directions of nuclear hyperfine coupling tensor for the free radical, electron spin resonance patterns, plots of the outside components of triplets I and II for various orientations, and a diagram of relative orientation of observed free radicals are presented. Further, a more recent analysis by others for the $CHFCONH_2$ free radical is in general agreement with the results of this analysis. E.E.B.

N65-22297 Frankford Arsenal, Philadelphia, Pa.
THE EFFECT OF REACTOR IRRADIATION UPON HYDROGEN ADSORPTION BY AN ALUMINA CATALYST
D. B. Rosenblatt and G. J. Dienes (Brookhaven Natl. Lab.) *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 283–295 refs Sponsored by Army and AEC (See N65-22275 12-34)

The material used in these experiments was aluminum oxide, reported to consist chiefly of gamma aluminum oxide particles of about 80 Å with a few relatively large 3500 Å alpha alumina grains. After evacuation to pressures of 5 to 10 mm Hg at room temperature, the specific surface areas of the samples were determined by nitrogen adsorption at 78° K. Hydrogen isotherms were obtained at this temperature by admitting known quantities of the gas into a constant volume apparatus containing the sample and measuring the pressure at equilibrium. The ampules containing the samples were then evacuated, sealed, and irradiated to doses of about 10^{18} nvt at 50° C. After again degassing, measurements of nitrogen and hydrogen adsorption were repeated. The isotherms obtained for hydrogen adsorption before and after irradiation are shown. Irradiation affected not only the amount of adsorption but also the shape of the isotherm. It was found that 24 cc/gm of hydrogen would complete a monolayer. The area occupied by a hydrogen molecule was calculated to be 13.2 $(Å)^2/H_2$ molecule. Significant findings for nitrogen are also reported. E.E.B.

N65-22309 Frankford Arsenal, Philadelphia, Pa.
PHOSPHORUS, ARSENIC, AND BORON-CONTAINING FERROCENE DERIVATIVES
G. P. Sollott, J. L. Snead, S. Portnoy, W. R. Peterson, Jr., and H. E. Mertwoy *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 441–452 refs (See N65-22275 12-34)

The preparation of diferrocenyl-phenylphosphines by reactions of p-methoxy-, p-methyl-, p-chloro-, and p-cyanophenylphosphonous dichlorides with ferrocene under Friedel–Crafts conditions was reported. Also, ferrocene was found to react with arsenic trichloride in the presence of anhydrous $AlCl_3$ to give only monosubstitution on arsenic. Further, ferrocenylarsenic oxide was converted to ferrocenyldichloroarsine and bis-ferrocenylchloroarsenic and bis-ferrocenylhydroxyarsenic oxides. Ferrocenylboronic acid was prepared by the reaction of ferrocene with BCl_3, and the boronic acid was converted to ferrocenylboronic anhydride trimer. The preparation of 1,1'-bis-diphenylphosphino ferrocene and ferrocenyldiphenylphosphine, and their arsenic analogs by reactions with mixtures of mono- and di-lithioferrocenes was also announced. E.E.B.

N65-22313 Army Chemical Center, Edgewood, Md. Chemical Research Div.
DESIGN AND REACTION MECHANISM OF SHORT-LIVED ALKYLATING AGENTS
Charles E. Williamson, Jacob J. Miller, Samuel Sass, and Benjamin Witten *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 493–506 refs (See N65-22275 12-34)

Alkylating agents exert a wide spectrum of biological activity, producing radiation type symptoms, chromosomal aberrations, mutations, and carcinogenic as well as cancer chemotherapeutic effects. An investigation to better define the chemical actions of these compounds as they relate to the above areas of interest is reported. About 30 new aliphatic sulfur mustards of widely varying structures were synthesized, and their activities in aqueous media were determined. It was concluded that in aqueous buffered media or in other biological systems such as blood, the life of the aliphatic sulfur mustards depends upon the rate of ethylene sulfonium ion formation. A kinetic study of this rate-controlling step has led to a more comprehensive understanding of the reaction mechanism of the alkylating agents. The major factors influencing the reactivity of these agents are included. E.E.B.

N65-22347# General Precision, Inc., Little Falls, N. J. Aerospace Research Center
HIGH TEMPERATURE RESISTANT PHTHALOCYANINE POLYMERS Quarterly Progress Report, 1 Nov. 1964–31 Jan. 1965
Jerome Luloff and Calvin Vogel 15 Feb. 1965 36 p refs (Contract NObs-92081) (QPR-1; AD-611537)

The program is concerned with the preparation and evaluation of metallophthalocyanine polymers to be used as high temperature stable insulating elastomers, resins and coatings for electrical and electronic devices. The program deals mainly with the synthesis of high-molecular-weight copolymers in which the metallophthalocyanine unit is bonded to the primary polymer chain through residual valencies on the central metal atom rather than through the peripheral carbon atoms. In this way, the intrinsic high chemical and thermal stability of this polynuclear aromatic system may be retained and contribute to the overall stability of the polymer. Based on the behavior of model compounds, copolymers employing metallophthalocyanine units in the polymer backbone are expected to remain stable up to about 5000° C. A 1:1 resorcinol silicon phthalocyanine copolymer was isolated by the pyrolytic elimination of resorcinol from diresorcinoxysilicon phthalocyanine. The polymer was a dark blue, powdery material which was apparently unaffected by heating in air to temperatures attainable with an ordinary bunsen burner. Progress was made with the development of an improved high-yield process for the synthesis of good-quality dichlorosilicon phthalocyanine. TAB

N65-22383# Naval Research Lab., Washington, D. C. Chemistry Div.
INVESTIGATION OF FATTY ACID MONOLAYERS ON METALS BY CONTACT POTENTIAL MEASUREMENTS
C. O. Timmons and W. A. Zisman 10 Feb. 1965 19 p refs (NRL-6208; AD-613269)

Each of the homologous series of pure N-fatty acids—from formic to hexacosanoic—was studied as a condensed monomolecular layer adsorbed on Pt and NiO substrates. Both the stearic and nonadecanoic acids were also studied on various polished metal surfaces including Fe, Cr, Cu, Au, W, Mo, Ag, Nb, Al, Cd, Mg, Sn, Pb, Be, Zn, and Ni. The change in contact potential difference (δV) between the metal and an aged reference electrode was measured in air at 23° C and 50% R.H. Surface packing in each monolayer was characterized by the methylene iodide contact angle (θ). Systematic and reproducible values of δV and θ were found for each member of the homologous series. Values of θ for stearic acid varied with the nature of the metal substrate, and the results were in reasonable accord with the lattice spacing of the substrate atoms. Values of δV for stearic acid monolayers varied from a maximum of 0.365 volt on W to −0.095 volt on Pb, and it was concluded that the perpendicular component of the dipole moment of the adsorbed acid molecule was a function of the specific interaction of metal substrate and the acid carboxylic group. Stearic acid desorbed readily from Pt but not from NiO, and it was concluded that chemisorption had occurred on the NiO. Author

N65-22407# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAKING USE OF THE PHENOMENON OF POSITIVE SURFACE IONIZATION IN INVESTIGATIONS OF CATHODE ATOMIZATION OF METALS

E. F. Chaykovskiy and G. V. Ptitsyn 9 Mar. 1965 7 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 12, 1964 p 2194–2196
(FTD-TT-65-175/1+2; AD-612421)

Platinum and nickel surfaces were ionized by bombardment with stable positive ion beams produced by potassium ions. The special instrument layout used, including emitter, collector, and vaporizer, is described. It was possible to obtain stable ion beams of different intensities from 100 to 500 volts by changing the pressure of the potassium vapor. The coefficient of the cathode atomization was determined by a formula based on the number of atomized atoms, the number of incident ions, the change in weight of the collector, the atomic number of the collecting material, the charge of the electron, the density of the ion flux, the mass of the hydrogen atom, and the atomization time. A plot of the data shows that the coefficient of cathode atomization has a linear relationship to the potential energy of the incident ions. L.S.

N65-22409# Oxford Univ. (England). Clarendon Lab.
TETRAHEDRAL FERRIC COMPLEXES IN SILVER HALIDES Scientific Report No. 5
W. Hayes, J. R. Pilbrow, and L. M. Slifkin 30 Sep. 1964 25 p refs
(Contract AF 61(052)-677)
(AFCRL-65-120; AD-612655)

Single crystals of AgCl and AgBr which contained iron impurity in the ferrous state were annealed in chlorine and bromine gas at about 350° C for approximately one half hour. An investigation by E.S.R. methods, after quenching to room temperature, showed that a portion of the iron impurity was oxidized to the ferric state. The stability of the ferric state at room temperature is dependent on the dislocation content of the crystals. It is suggested that the ferric ions are present interstitially in the crystal, forming a complex which may be described as (FeX_4)—where X is a halogen; the model in the case of AgCl requires association of the ferric ion with four nearest neighbor silver ion vacancies. Author

N65-22414# Radio Corp. of America, Princeton, N. J. RCA Labs.
TRACE ANALYSIS OF SOLIDS BY MASS SPECTROMETRY Final Report, Oct. 1, 1963–Nov. 30, 1964.
Richard E. Honig Dec. 1964 188 p refs
(Contract AF 19(628)-446)
(AFCRL-65-38; AD-613324)

The report describes studies made on a doublefocusing mass spectrograph to improve its performance in the field of trace analyses, particularly the quantitative aspects. Novel approaches to ion-detecting as well as ion-generating schemes are described. Author

N65-22416# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
TOTAL ANALYSIS OF METALLIC IONS BY THIN-LAYER CHROMATOGRAPHY
Shoji Takitani et al Feb. 1965 8 p refs Transl. into ENGLISH from Bunseki Kagaku (Tokyo), v. 13, no. 5, 1964 p 469–471
(RSIC-371; AD-612691)

An investigation was made on the effect on cation detection in the usual systematic qualitative analysis of cations, in the presence of possibly interfering anions such as borate, phosphate, sulfate, arsenate, oxalate, and tartrate. There is no interference with most of the metal ions. With respect to the metal ions, a specific quantity was made into a spot by means of a micrometer. Then after spreading, the identification limits of various detection methods were determined. When the same identification methods are compared in paper chromatography, in general, thin-layer chromatography is more sensitive, the ions which are 10–100 times more sensitive predominating. Finally, reliability of ion identification methods was considered and a cation analytical method combining the previous methods of systematic analysis with the present method was investigated. After the major separation of cations into families using NH_4SH, qualitative identification of each ion by means of thin-layer chromatography was accomplished. The time required, compared to qualitative analysis only, was shortened, positive identification of ions was made, and the method is thought to be useful in qualitative analysis of cations. TAB

N65-22417# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
INFRARED SPECTROSCOPY STUDY OF ORGANOSILICON COMPOUNDS
Annette Marchand, Marie-Thérèse Forel, Franck Metras, and Jacques Valade Feb. 1965 36 p refs Transl. into ENGLISH from J. Chim. Phys. (Paris), v. 61, no. 3, 1964 p 343–362
(RSIC-377; AD-612653)

Infrared spectra were recorded between 400 and 1600/cm, in the region of 2000/cm, and between 2700 and 3500/cm for six organic siloxanes $R_3SiOSiR_3$, eight organic silazanes $R_3SiNHSiR_3$, seven amino- or diaminosilanes without substitution for the nitrogen of R_3SiNH_2 or $R_2Si(NH_2)_2$ and for triphenylsilane and diisopropylsilanol (iso-C_3H_7)2HSiOH. The attributions of the characteristic vibrations of the SiOSi, SiNHSi, $SiNH_2$, $Si(NH_2)_2$ and SiH groups, as well as those of the substituents bonded to the silicon: CH_3, C_2H_5, $(CH_3)_2CH$, C_6H_4 and C_6H_5 are discussed. Author

N65-22437* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE ORIGIN OF THE PRODUCTS OF THE PYROLYSIS OF PHENOL-FORMALDEHYDE TAR
V. D. Moiseyev, M. B. Neyman, and Ye. N. Raspopova 24 Mar. 1965 11 p refs Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 6, 1960 p 11–13
(FTD-TT-64-997/1+2; AD-613451)

By the method of labelled atoms it was shown that, in the case of thermal degradation of phenol-formaldehyde resin, the greater part of the carbon of methylene cross links of the tar takes part in the formation of graphite (coke), and is not given off in the form of gas. By the same method it was shown that the gases which contain carbon in the degradation of the tar are formed not only from the cross-link methylene groups, but also from the aromatic rings, i.e., there occurs a disconnecting of some part of the rings. TAB

N65-22440*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING MULTIFUNCTIONAL ADDITIVES TO LUBRICATING OILS
A. I. Kartashevskiy and E. S. Tetel'baum 18 Mar. 1965 51 p Transl. into ENGLISH from Russian Patent no. 160251 (Appl. no. 811718/23-4), 2 Jan. 1963 1 p
(FTD-TT-64-1087/1; AD-613175)

The object of the invention is a method of obtaining multifunctional additives for lubricating oils. Products of the oxidation of paraffine were treated with pentasulfide of phosphorus with subsequent neutralization of the product obtained in the presence of alkylphenol compounds. TAB

N65-22444* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF PRODUCING NITRIC ACID
Ye. A. Kazakova, N. S. Trifonova, and I. M. Zelichenok 22 Mar. 1965 5 p Transl. into ENGLISH from Russian Patent no. 161701 (Appl. no. 785821/23-4), 6 Jul. 1962 1 p
(FTD-TT-64-1194/1; AD-613455)

The object of the invention is a method of obtaining nitric acid from a gaseous mixture, which contains nitrogen oxide, oxygen and other gases by the method of cooling the mixture and passing it through an adsorber with fluidized layers of absorbent, for example, silica gel, which is distinguished by the fact that, for the purpose of lowering the cost and simplifying the technological process, steam is passed into the absorbent and separated out by desorption under a vacuum at a temperature of 80° to 120° C with the blowing through by air nitric acid in the vapor phase. For the purpose of intensifying the process, the adsorption and synthesis are accomplished under pressure up to 10kG/sq.cm. TAB

N65-22455# Group for the Advancement of Spectroscopic Methods, Paris (France).
RESEARCH ON BASIC FAR-INFRARED TECHNIQUES Final Scientific Report, 15 Dec. 1962–20 Dec. 1964
A. Hadni and J. Lecomte 20 Jan. 1965 13 p refs
(Contract AF 61(052)-662)
(AFCRL-65-204; AD-613966)

Studies are reported on: far infrared electronic transitions in ions and pairs of ions, absorption spectra of polar and nonpolar molecules in the liquid state, and far infrared emission of the high pressure mercury arc. The behavior of low frequency electronic transitions of ions imbedded in various lattices was observed in anhydrous praseodymium chloride, diluted anhydrous samarium chloride, and in the concentrated ruby. In the 4-f states of rare earth ions, ions were slightly split by the crystal field. In the concentrated ruby, slight coupling between two neighbor ions occurred. Absorption spectra in acetonitrile, propionitrile, and methyl formiate, were studied in the gaseous and liquid state. All polar molecules absorbed as strongly in the liquid state as in the gaseous state. The possibility of there being both Debye absorption and free rotations for some molecules was established. The advantages of modulating the mercury arc for eliminating the near and middle infrared emission of the lamp are discussed. Technical information on a far infrared gallium-doped germanium detector and high accuracy low and high voltage supplies for a low noise, low frequency amplifier, is also included. S.C.W.

N65-22459# Oklahoma State Univ., Stillwater.
MOLECULAR FLOW AND THE EFFUSION PROCESS IN THE MEASUREMENT OF VAPOR PRESSURES. PART II: ADDITIONAL DATA AND DETAILS OF EQUIPMENT Technical Documentary Report, 1 Jun. 1963–31 Aug. 1964
Robert D. Freeman Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 113 p refs
(Contract AF 33(657)-8767)
(ASD-TDR-63-754, Pt. II; AD-612958)

Details are given for molecular beam apparatus for the measurement of the angular distribution of molecules effusing from nonideal orifices. The vacuum microbalance and furnace which are used in the microbalance-inverted Knudsen effusion-recoil (miker) technique for determining vapor pressures and molecular weights are described in detail. Miker results are given for the vapor pressure of silver, gold, and calcium fluoride. Some data on the diffusion of silver and gold vapors through graphite cell walls resulted as a byproduct of these studies. Values obtained for the molecular weights of tin and calcium fluoride vapors are somewhat ambiguous, but do indicate that improvements in the technique are still possible and necessary. An analysis of the rate of effusion from a cooling Knudsen effusion cell is given. The complete details of an analysis and computation of transmission probabilities, angular distribution functions, and recoil force corrections for conical and cylindrical orifices are now available. Author

N65-22471# Akron Univ., Ohio. Inst. of Rubber Research
LOW TEMPERATURE POLYMERIZATION STUDIES Progress Report, Jan. 1–Mar. 31, 1965
Maurice Morton 10 Apr. 1965 30 p refs
(Contract AF 04(611)-9694)
(PR-5; AD-613529)

This report contains results on the polymerization or attempted polymerization of the following monomers by gamma radiation (7.6 rad/hr) at reduced temperatures: acrylonitrile, hexafluoropropylene, fumaronitrile, hexafluoroacetone, trifluoroacetaldehyde, perfluorooctanal, and pentafluoropropionaldehyde. A differential thermal analysis assembly was constructed for use during polymerization by gamma radiation and was applied in the solid-state polymerization of acrylontrile. The results qualitatively indicate that polymerization occurs only in the temperature vicinity of a phase transition. Hexafluoropropylene was found to polymerize slowly at −74° C to form a sticky substance soluble in its monomer. Author

N65-22474# Naval Research Lab., Washington, D.C. Chemistry Div.
A MASS SPECTROMETRIC METHOD FOR THE DETERMINATION OF PERMEABILITY COEFFICIENTS
F. E. Saalfeld and M. V. Mc Dowell 30 Dec. 1964 11 p refs
(NRL-6182; AD-611572)

A method for the determination of permeability coefficients from mass spectral data has been described in detail. The method has been illustrated by the determination of permeability coefficients for the systems N_2-neoprene, O_2-neoprene, and CO_2-neoprene at room temperature. The value for the permeability coefficient Q for CO_2 through neoprene has been shown to be independent of membrane thickness with diaphragms of 0.081 and 0.200 cm thickness ($Q = 13.1 \pm 0.3 \times 10^{-11}$ and $13.3 \pm 0.2 \times 10^{-11}$ cm^2 sec^{-1} $torr^{-1}$, respectively). The data presented shows that Q increases with a decrease in the pressure of 1.0 to 0.5 atmosphere across the membrane. For the CO_2-neoprene system, the values of Q for pressure differentials of 1.0, 0.75, and 0.50 atmosphere are $13.3 \pm 0.02 \times 10^{-11}$, $16.2 \pm 0.2 \times 10^{-11}$, and $19.2 \pm 0.1 \times 10^{-11}$ cm^2 sec^{-1} $torr^{-1}$, respectively. For the same three pressure differentials with N_2-neoprene, the values of Q were found to be $2.87 \pm 0.04 \times 10^{-11}$, $5.80 \pm 0.03 \times 10^{-11}$, and $7.00 \pm 0.03 \times 10^{-11}$ cm^2 sec^{-1} $torr^{-1}$, respectively. This trend was not checked for the O_2-neoprene system due to experimental difficulties. The values for Q at a pressure differential of 1 atmosphere agree with previously published values. Author

N65-22489# Space-General Corp., El Monte, Calif. Chemical Div.
64.168^{11} NMR SPECTRA: CHLORODECABORANES IDENTIFIED AS 1-$CIB_{10}H_{13}$ AND 2-$CIB_{10}H_{13}$
Robert E. Williams and Eugene Pier 1 Jan. 1965 5 p refs Submitted for Publication
(Contract Nonr-4381(00))
(TR-2; AD-456783)

Nuclear magnetic resonance studies indicating that 1-$CIB_{10}H_{13}$ and 2-$CIB_{10}H_{13}$ should be added to the list of

halogen derivatives of B_2H_6, B_4H_{10}, B_5H_9, and $B_{10}H_{14}$ are reported. The spectrum of 1-$ClB_{10}H_{13}$ (melting point = 73° C) presented is in such great detail at 64.16 Mc that the only interpretation discussed is the assignment of the substitution to the 1 position. The other spectrum shows the spectrum expected of 2-$ClB_{10}H_{13}$—collapse of a portion of the high field doublet and the predicted shift to lower field. However, the presence of an even greater amount of 1-$ClB_{10}H_{13}$ is detected, indicating that the presumed $ClB_{10}H_{13}$ isomer (melting point = 59° C) is in reality a mixture of the two isomers, which accounts for the lower melting point. M.P.G.

N65-22494# Navy Electronics Lab., San Diego, Calif.
CRYSTAL GROWTH OF WATER-INSOLUBLE SUBSTANCES USING COMPLEXING AGENTS
J. V. Kerrigan 16 Nov. 1964 32 p refs
(NEL-1250; AD-457082)

The results are presented of preliminary experiments in transporting and depositing water-insoluble materials in an aqueous phase through application of the principles of coordination-compound, complex-ion, and ion-association chemistry. Feasibility of growing crystals and crystalline films is demonstrated. Crystal products are of interest in microelectronics, catalysis, and ceramics. Author

N65-22495# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SPECTROSCOPIC STUDIES OF THE VAPORIZATION OF REFRACTORY MATERIALS Annual Report, 1 Nov. 1963–30 Nov. 1964
Milton J. Linevsky Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1965 62 p refs
(Contract AF 33(615)-1150)
(AFML-TR-64-420; AD-461476)

The technique of matrix isolation was used to obtain the infrared spectra of several high temperature molecules. A double boiler and reaction oven-type Knudsen cell technique were added to the general methods of matrix isolation resulting in greater versatility of the method. Differentiation between monomer and polymer spectra appears to be entirely possible. The following molecules were studied: MgF_2, AlF_3, Li_2F_2, ThO_2, ThO, ZrO_2 and ZrO. In most cases tentative frequency assignments were made and structural properties inferred. Atomic resonance line absorption studies were carried out on HfB_2, TiN and ZrN. Heats of formation were obtained based on the observed vapor pressures. Author

N65-22506# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
THEORETICAL INVESTIGATION OF THE OXYGEN HYDRIDES BY USING THE UNITED ATOM METHOD
Krzysztof Pecul Jul. 1964 31 p refs
(Rept.-550/XVII)

The energies and one-center single determinant wave functions of OH_M^p oxygen hydrides and of some isoelectronic systems were calculated. Orthonormalized Slater-type orbitals were employed. It was shown that they give more accurate energies and bond lengths than the Fock–Petrashen-type orbitals. Using semiempirical corrections OH bond lengths for OH^-, H_2O^+ and H_3O^+ were estimated. The accuracy of the approximations, and the possibilities of further applications of the model were also discussed. Author

N65-22509# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research
THE STUDIES OF AMMONIUM ION MOTIONS IN SOLID SOLUTIONS
Kazimerz Mikke and Ludwik Dobrzynski Nov. 1964 18 p Presented at the Intern. Atomic Energy Agency Symp. on the Inelastic Scattering of Neutrons, Bombay, 15–19 Dec. 1964
(Rept.-569/II)

Pure NH_4I, studies by means of inelastic scattering of neutrons, shows in liquid nitrogen temperature a sharp peak connected with the hindered rotation of ammonium ions, and a broad distribution at room temperature attributed at that time to free, or nearly free rotation. To study how these motions depend on the ammonium ion–ion interaction, the energy distribution of initially monochromatic neutrons scattered inelastically at 90° from solid solutions of ammonium iodide in potassium iodide was measured by the inverted filter method. Measurements were at room and liquid nitrogen temperatures for two samples of concentration of about 17% and 25% of NH_4I in KI. Analysis of results shows that the sharp peak observed at liquid nitrogen temperature for pure NH_4I is due to a strong ammonium ion–ion interaction. The results are compared with Krieger–Nelkin theory. A model of simultaneously existing different types of rotation is proposed. Author

N65-22511# FMC Corp., Princeton, N. J. Central Research Dept.
[DEVELOPMENT OF HIGH STRENGTH CHEMICAL RESISTANT RUBBERS AND FLUORINE-CONTAINING POLYMER SYSTEMS] Progress Report IV, 27 Mar.–25 Jun. 1964
J. A. Gannon, C. A. Erickson, and E. W. Cook 15 Jul. 1964 36 p refs
(Contract DA-19-129-AMC-147(N))
(PCR-397; AD-613945)

Hydrogen-containing oxetanes were successfully prepared for the first time by the photolysis of hexafluoroacetone with ethylene and vinylidene fluoride. In both cases polymeric products, in addition to oxetanes, were found. All of the polymeric products isolated are of low molecular weight. A new elastomer system was discovered involving the condensation of a fluorine-containing diol with a fluorocarbon diene. This product is being characterized, but its low T_g(−57° C) is very encouraging. Attempts to modify the $C_3F_6/CF_2{=}CH_2$ system by incorporation of termonomers proved unsuccessful, as did attempts to use the thermal cycloaddition of fluorocarbons as a polymer forming reaction. Author

N65-22513# Case Inst. of Tech., Cleveland, Ohio. Dept. of Chemistry
POSSIBLE OCTAHEDRAL COORDINATION OF SILICON AND GERMANIUM BY NITROGEN
Albert J. Starshak, S. J. Kenney, and Malcolm E. Kenney 2 Feb. 1965 7 p refs Submitted for Publication
(Contract Nonr-1141(8))
(TR-3; AD-456777)

For the pseudohalo compounds of silicon and germanium there is a possibility that the groups are nitrogen bonded to the metal. This possibility has led, in the course of a search for silicon and germanium phthalocyanines having the central metal octahedrally coordinated by nitrogen, to the synthesis and infrared study of the pseudohalo phthalocyanino derivatives of these two metals. Author

N65-22550*# Western Ontario Univ., London. Dept. of Physics
IDENTIFICATION ATLAS OF MOLECULAR SPECTRA I: THE AlO $A^2\Sigma$–$X^2\Sigma$ BLUE-GREEN SYSTEM

D. C. Tyte and R. W. Nicholls 10 Mar. 1964 15 p refs
(Grants NsG-349; AF-AFOSR-62-236A; Contracts AF 19(628)-2820; DRB MM-69-300002)
(NASA-CR-62398) CFSTI: HC $1.00/MF $0.50

This report contains a set of vibrationally identified spectrograms of the Blue–Green ($A^2\Sigma$–$X^2\Sigma$) system of AlO. A compilation of all the available molecular data on the states involved, a brief description of the appearance, occurrence and history of the system, and a selected bibliography are also included. Author

N65-22621*# National Aeronautics and Space Administration, Washington, D. C.
FORMATION OF MELANOIDINES FROM CHITIN [OBRAZOVANIYE MELANOIDINOV IZ KHITINA]
S. M. Manskaya, T. V. Drozdova, and K. I. Tobelko Apr. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 96, no. 3, 1964 p 569–572
(NASA-TT-F-9330) CFSTI: HC $1.00/MF $0.50

Chitin is a high-molecular compound found extensively in nature. Recently, bacteria which destroy chitin have been discovered. Melanoidines result from the interaction of amino acids and sugar (Maillard reaction). An attempt to simulate the process of melanoidine formation from glucosamine and chitin is made. The process is found to be similar to the melanoidine formation process from sugar and amino acid. Using the Debye powder pattern method, the melanoidines are found to be amorphous, whereas chitin and glucosamine are crystalline. Author

N65-22648 Joint Publications Research Service, Washington, D. C.
CHROMATOGRAPHIC QUANTITATIVE ANALYSIS BY HYDROGEN IONIZATION DETECTOR
T'ai-ch'ien Li and Shao-i P'eng *In its* Transl. on Communist China's Sci. and Technol., No. 170 14 Apr. 1965 p 47–54 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 2, Feb. 1965 p 161–163 (See N65-22645 12-34) CFSTI: $3.00

A method for calculating relative molar response is presented to promote the usefulness of hydrogen ionization detectors in chromatography. The method is based on the product k(E-V)A, where E is the energy of the excitation source, V is the ionization potential of the ionized substance, A is the product of the ionization and molecular cross sections, and k is the proportionality constant dependent on the structure of the ionization detector. The relative molar response—also called the molar correction factor—for one compound compared to another is the ratio of the k(E-V)A values for the compounds. Calculations for an aromatic hydrocarbon, an alkane, and a fatty acid revealed that the correction factor is linearly related, with positive slope, to the number of carbon atoms in the homologous compounds. A simplifying assumption was introduced in the correction factor, and a comparison of the exact and approximate formulas was made for various hydrocarbons, and it was concluded that the approximation was satisfactory. J.M.D.

N65-22649 Joint Publications Research Service, Washington, D. C.
EFFICIENCY ADSORPTION COLUMN ANALYSIS OF GASEOUS HYDROCARBONS
Li-chih Hu and Shao-i P'eng *In its* Transl. on Communist China's Sci. and Technol., No. 170 14 Apr. 1965 p 55–60 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 2, Feb. 1965 p 163–165 (See N65-22645 12-34) CFSTI: $3.00

Efficiency of the filled column used in column adsorption chromatography of gaseous hydrocarbons was increased by covering the inert supporter with a thin layer of adsorbent. Aluminum isopropoxide was used as an adsorbent, which hydrolyzed rapidly at the supporter surface to form an evenly distributed thin layer of aluminum oxide; experimental results using this adsorbent showed total time for analysis of gaseous hydrocarbons to be about 1' minute. The column efficiency was maximum when the ratio of aluminum oxide to supporter was 10% to 15% and the activation temperature was 600° C. The quantitative and qualitative reproducibilities were found to be excellent. Effects of various adsorbent preparations and experimental conditions on separation efficiency were studied. Interrelationships among various column operation variables, and their effects on column efficiency, were also investigated. J.M.D.

N65-22661# American Meteorological Society, Boston, Mass.
MASS SPECTROMETER STUDY OF THE REACTION $X^+ + H_2 \rightarrow HX^+ + H$ [MASSENSPEKTROMETRISCHE UNTERSUCHUNG DER REAKTION $X^+ + H_2 \rightarrow HX^+ + H$]
H. Gutbier Bedford, Mass., AFCRL Sep. 1964 20 p refs Transl. into ENGLISH from Z. Naturforsch. (Tübingen), v. 12a 1957 p 499–507
(Contract AF 19(628)-3880)
(T-G-197; AD-454628)

A series of mass spectrometer measurements on various gas-hydrogen mixtures was carried out to obtain more information about the formation of HX^+ ions and to define the cross section for formation of various HX^+ ions. It was found that the HX^+ formation is proportional to the X^+ and H_2 concentrations and is inversely proportional to the velocity of the X^+ ions. The effective cross section as well as the specific rate of formation of the HX^+ was measured for the X^+ ions H_2^+, He^+, Ne^+, Ar^+, Kr^+, N_2^+, O_2^+, and CO_2^+ and was found to be in the order of 10^{-15} cm^2 at an average kinetic energy of 0.25 eV. The H_2, HF, HCl, and HBr molecules were found to correspond to the HHe^+, HNe^+, HAr^+, and HKr^+ ions. G.G.

N65-22701# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
SPECTROSCOPIC STUDIES OF THE VAPORIZATION OF REFRACTORY MATERIALS Third Quarterly Report
Milton J. Linevsky [1964] 11 p refs
(Contract AF 33(615)-1150; ARPA Order 24)
(AD-611856)

Matrix isolation spectra in solid argon were obtained on O^{18} enriched ThO_2. From the resulting spectra it appears that the molecule is highly bent. Frequencies were assigned to the V_1 and V_3 vibrational fundamentals for all the various isotopic species. The V_2 was not observed in the frequency region (2 microns to 55.5 microns) covered and must be presumed to be less than 180/cm. Modifications of our spectroscopic equipment were made and it is now possible to obtain infrared spectra down to 180/cm. Examination of the long wavelength regions of the spectra of MgF_2 and AlF_3 using this modified equipment was made and additional spectra for lithium fluoride were obtained. Resonance line studies were initiated on ZrN in a manner completely analogous to that used in the tin study. However, much difficulty was encountered because of the reaction of the ZrN with carbon. Modifications of the furnace are being made to try to mitigate this reaction. TAB

N65-22741 Army Natick Labs., Mass. Pioneering Research Div.

POTENTIAL RADIATION-PROTECTIVE COMPOUNDS. SYNTHESIS OF THE THREE ISOMERIC THREE-CARBON AMINOHYDROXY BUNTE SALTS AND RELATED COMPOUNDS

D. H. Ball, J. M. Williams, and L. Long, Jr. *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 115–120 refs (See N65-22732 12-34)

The synthesis of three isomeric internal Bunte salts (S-alkyl thiosulfates) as potential radioprotective agents is given. Bunte salt I, S-3-amino-2-hydroxy-propyl thiosulfuric acid, was isolated in 67% yield. Bunte salt II, S-2-amino-1-(hydroxymethyl) ethyl thiosulfuric acid, was isolated in 51% yield. Bunte salt III, S-2-amino-3-hydroxypropyl thiosulfuric acid, was isolated in 65% yield. Optical rotation studies on the precursors to Bunte salt III were conducted. All three isomers are stable crystalline solids, are very soluble in water, are slightly soluble in methanol, and decompose slowly in boiling water. All three compounds showed slight activity when tested as radioprotective agents. L.S.

N65-22743 Army Engineer Research and Development Labs., Fort Belvoir, Va.

A PARAMAGNETIC RESONANCE STUDY OF NITROGEN ATOMS TRAPPED IN X-IRRADIATED ALKALI AZIDES

Frederick F. Carlson *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 135–147 refs (See N65-22732 12-34)

The electron paramagnetic resonance spectrum of S state nitrogen atoms trapped in X-irradiated potassium, rubidium, cesium, and sodium azides is described in terms of a spin Hamiltonian. A discussion of the fine structure parameter constants D and E in the Hamiltonian is given in an attempt to understand how the zero field splittings arise. Point charge lattice sums for the tetragonal azides were calculated to see in which direction the field gradient changes for the alkalis. Discrepancies between the calculated results and the Chakravarty and Bersohn point charge model are explained by taking into account the effects of the size of the nearest neighbor ion, and the size of the lattice trap. Where the overlap of the wave function is large, the formation of a chemical bond may occur. The postulation that N atoms would be more tightly bonded to KN_3, RbN_3, and CsN_3 than to NaN_3 was verified by experimentation. Theoretically, cesium azide is the best material for stabilization of nitrogen atoms, but other factors such as X-ray penetration and crystal density are involved. The highest concentration (less than 0.01%) of N atoms was obtained with the lightest azide, NaN_3. Although the azide crystal system does not represent a satisfactory concentration for use as an energy source, it can be used at higher temperatures (150° K) and represents a great improvement over the classical frozen gas matrix system where nitrogen atoms are not stable above 20° or 30° K. L.S.

N65-22744 Picatinny Arsenal, Dover, N. J. Explosives Lab.

NITROGEN-15 TRACER STUDIES OF THE NITROLYSIS OF HEXAMETHYLENETETRAMINE

Thomas C. Castorina and Joseph R. Autera *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 163–177 refs (See N65-22732 12-34)

A nitrogen-15 tracer study of the ammonium nitrate nitrolysis of hexamethylenetetramine to yield HMX and RDX end products was conducted to study the structure of the intermediate DPT. The DPT contains two types of nitrogen bonding, each of which was traced individually to show which end product is formed. Addition of paraformaldehyde to the starting reaction mixture changes the HMX/RDX product ratio. The N-15 tracer studies, used in conjunction with previous C-14 tracer data in determining the mechanism of splitting of the intermediate, indicate that ammonium nitrate does not condense directly to yield HMX and RDX, but rather that the ammonium radical condenses with the equilibrated methylene fragments. The equilibration of methylene groups was found to be independent of ammonium concentration, and the equilibration of aminonitrogen was found to be independent of paraformaldehyde concentration. The intermediate is thus postulated to be of the type $HOCH_2NHNO_2$. Apparently paraformaldehyde increases the concentration of methylene groups in the intermediate DPT. The evidence given for the existence of a common intermediate precursor to HMX/RDX justifies any effort to prepare HMX from monomethylene-containing compounds. L.S.

N65-22750 Army Research Office, Durham, N. C.

HINDERED ROTATION IN AMINOBORANES

John W. Dawson and Kurt Niedenzu *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 251–260 refs (See N65-22732 12-34)

Aminoboranes are conventionally illustrated by the basic structure

The fundamental character of the B–N bond was examined by consideration of physical and chemical data on the aminoboranes. The physicochemical properties of the alkylated aminoboranes are in close agreement with those of the corresponding ethylene derivatives which suggests a consistent tendency of the π-electrons of the nitrogen to participate in boron–nitrogen bonding. Further, the preparation of organic substituted aminoboranes by the Grignard reagents is discussed. The availability of a great variety of these compounds permits an evaluation of the influence of substituents on the B–N linkage. Further, infrared spectra of aminoboranes reveal additional information on the B–N bond. Evidence of the N–B linkage from nuclear magnetic resonance is discussed in detail. It was concluded that the concept of restricted rotation in aminoboranes due to B–N double bonding seems well founded as indicated by the chemical, physicochemical, and mathematical evidence presented. E.E.B.

N65-22753 Frankford Arsenal, Philadelphia, Pa.

PREPARATION OF 5-DINITROMETHYLTETRAZOLE FROM SALTS OF DINITROACETONITRILE

F. Einberg *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 289–299 refs (See N65-22732 12-34)

The preparation of 5-nitroalkyltetrazole by the reaction of sodium or ammonium dinitroacetonitrile with sodium azide and ammonium chloride in water refluxing is reported. Further, it was found that the reaction would not work with the potassium salt nor with dimethylformamide. This appears to be the first example of the use of an organonitrile salt to form a tetrazole, and is the first example of 5-nitroalkyltetrazole preparation by this method. The yield of dinitromethyltetrazole after 24 hours of refluxing was essentially the same as that for 48 hours. However, the yield of the byproduct diammonium bitetrazone increased by a factor of three with the longer refluxing. The reaction in dimethylformamide appeared to produce only decomposition products. The mono- and disodium, monoammonium, and monoguanidine salts of the tetrazole also were prepared from the free dibasic acid. E.E.B.

N65-22765 Army Natick Labs., Mass.

PREPARATION AND USES OF SOME NEW ORGANOLEAD CHEMICALS

Malcolm C. Henry *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 469–476 refs (See N65-22732 12-34)

The significant developments in the synthesis, screening, testing, and production of organolead and organolead–sulfur chemicals were reviewed. It was found that organolead halides reacted with mercaptans in the presence of an organic base such as triethylamine to give excellent results for the preparation of the organolead–sulfur compounds. Further, in contrast to the mercaptans, these compounds are odorless. They have low melting points and may be recrystallized from common organic solvents. Among the uses found for the organolead compounds were these: fungicides, rodent repellants, lubricant additives, stabilizers for chlorinated polymers, and catalysts. E.E.B.

N65-22766# Pennsylvania Univ., Philadelphia.
OPTICAL AND MICROWAVE SPECTROSCOPY OF SOLIDS Status Report, 1 Jun.–30 Sep. 1964
M. Brodsky et al [1964] 7 p
(Contract Nonr-4551(00))
(AD-611286)

Research progress in the following areas is summarized: room temperature infrared reflection spectrum of LiH from 2000 to 400/cm; normal and oblique incidence IR transmission of thin CuCl films; theory and measurement of Azbel–Kaner cyclotron resonance in P-type PbTe crystals; observation of the plane of polarization of transverse acoustic waves in tellurium. TAB

N65-22772# National Lead Co. of Ohio, Cincinnati. Technical Div.
A SEMICONTINUOUS PROCESS FOR THE REDUCTION OF URANIUM TETRAFLUORIDE WITH MAGNESIUM
C. A. Neu, Jr., G. Brodi, D. L. Elston, J. H. Trapp, and O. R. Magoteaux (Charles Taylor Sons, Co., Cincinnati) 22 Apr. 1965 40 p refs
(Contract AT(30-1)-1156)
(NLCO-922) CFSTI: $2.00

A semicontinuous process to produce uranium metal by reducing uranium tetrafluoride (UF_4) with magnesium was developed and demonstrated on a pilot scale. The UF_4 was reduced in an induction-heated, graphite reactor, positioned in a rammed zirconia housing. After reduction, the molten metal was cast into pigs in iron molds, vacuum remelted, cast into ingots, and fabricated into fuel cores. The cores were found to be satisfactory for use in the production reactors. The operation and development of equipment as well as the results of pilot-scale demonstration tests are described. Author

N65-22799# American Oil Co., Whiting, Ind. Research and Development Dept.
SORPTION OF CARBONACEOUS FUELS AT ELECTRODES Progress Report, 22 Oct. 1964–21 Feb. 1965
R. J. Flannery, G. Aronowitz, and D. C. Walker Mar. 1965 61 p refs
(Contract DA-49-186-AMC-167(X))
(PR-1; AD-461427)

The radiolabeled sorption method was developed and applied to obtaining a concentration isotherm for radio-n-butane on sputtered platinum electrodes at 25° C in sulfuric acid electrolyte. The isotherm has not been obtained because of the occurrence of gradual deactivation of the electrodes, probably resulting from contamination of the electrode's surface with oxidation products. Voltammetric and coulometric studies of ethane oxidation on sputtered platinum in sulfuric acid electrolyte at 65° C have given some mechanistic insight into the role of adsorption in the overall oxidation process. Ethane is adsorbed in the potential range from 0.225 V NHE to 0.55 V, declining in amount at the more noble potentials. Oxidation begins at about 0.225 V and its rate increases at more noble potentials. At short times after activation of the electrode by potential cycling, the rates of ethane electrooxidation decay suggest an active site mechanism. The decay process is potential dependent and activated. At longer times, coverage by adsorbate appears to control the rate. Author

N65-22819# Hercules Powder Co., Wilmington, Del. Research Center
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE $-NF_2$ GROUP Annual Report, Mar. 1964–Feb. 1965
A. D. Craig and A. A. Albert 15 Apr. 1965 97 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order 402)
(HRC-65-1; AD-461314)

Experimental studies of the chemistry of the $-NF_2$ group are reported: the mechanism of electrochemical reduction of difluoramine in water, protonic organic solvents, and aprotic solvents; interactions of HNF_2 and CH_3NF_2 with some protonic acids; reactions of N_2F_4 and NF_3 with fluoride acceptors BF_3, BCl_3, and PF_5 in electrodeless electric discharges; high pressure reactions of NF_3 and $\cdot N_2F_4$ with BF_3 and PF_5; mass spectra of CH_3NF_2 and CF_3NF_2 obtained at 70 eV and at ionization potentials 8.5 to 14.0 eV; structures of NF_3 and HNF_2; and the electronic spectrum of CF_3NF_2 in the 2800- to 3600-Å region. J.M.D.

N65-22821# Los Alamos Scientific Lab., N. Mex.
THE SOLUBILITIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. III: TUNGSTEN
D. F. Bowersox and J. A. Leary 7 Apr. 1965 14 p refs
(Contract W-7405-ENG-36)
(LA-3252) CFSTI: $1.00

The solubility of tungsten in liquid plutonium was measured over the temperature range 700° to 1000° C. The solubility increased from 29 ppm (by weight) W at 700° C to 291 ppm W at 950° C. The data fit the empirical equation

$$\log N_W = 0.3518 - 4.639 \times 10^3\, T^{-1},$$

where N_W is the solubility expressed as the mole fraction of W, and T is the temperature in degrees Kelvin. Author

N65-22824# Wisconsin Univ., Madison.
REACTIONS BETWEEN SECONDARY AMINES AND ORGANOHALOGENATING AGENTS Semiannual Report, Jan. 1–Jun. 30, 1964
Takeru Higuchi 15 Jul. 1964 23 p
(Contract DA-18-108-AMC-209(A))
(SAR-2; AD-612010)

Kinetics of chlorine acceptance by succinimide suggests that the negative ionic form of the imide is responsible for the main course of the reaction. Additional data were obtained on the rate of reversible halogen transfer from N-chlorosuccinimide (NCSI) to various secondary amines. Preliminary results on the reactions of quinuclidine with halogenating agents indicate the great stability of the resulting chloroammonium form. The rate of formation on this species from hypochlorous acid and the base was determined. Although the mechanism of breakdown of NCSI in solution has not as yet been solved, several additional bits of information were obtained. TAB

N65-22850# Aerojet-General Nucleonics, San Ramon, Calif.
AMMONIA PRODUCTION FEASIBILITY STUDY. CESIUM-WATER HYDROGEN PRODUCTION PROCESS Final Technical Report, 2 Oct. 1964–29 Jan. 1965
H. C. Carney et al [1965] 193 p refs
(Contract DA-44-009-AMC-829(X))
(AN-1377; AD-460841)

The feasibility of producing hydrogen for use in the production of ammonia as a fuel for military vehicles and powerplants is reported. Work on the following is summarized: the experimental decomposition of cesium monoxide, and the formation of cesium hydroxide; the conceptual design of a hydrogen production plant; the results of a literature survey and an annotated bibliography on candidate containment materials; conclusions based on the analytical results; and recommendations for future work. The reference process described, and the conceptual design, maximize the direct use of thermal energy in the production of hydrogen. Author

N65-22864# Space-General Corp., El Monte, Calif. Chemical and Biological Div.
ASSIGNMENT OF 64.16 mc. B^{11} NMR SPECTRUM OF B_5H_{11}
Robert E. Williams, F. James Gerhart, and Eugene Pier 2 Jan. 1965 8 p refs Submitted for Publication
(Contract Nonr-4381(00))
(TR-3; AD-456784)

The B^{11} nuclear magnetic resonance spectrum of B_5H_{11} at 12.8 Mc was previously assigned as follows: a high field doublet representing the apex boron alone with a single terminal hydrogen and a superpositioned lower field doublet and triplet representing the base BH and BH_2 groups, respectively; a small unobscured member of a doublet could be unambiguously assigned to the approximately 10% B_5H_9 contaminant. The spectrum of B^{11} was obtained at 64.16 Mc on the nuclear magnetic resonance spectrometer and confirmed the previously assigned triplet and doublet. The structure of B_5H_{11} is discussed in light of the present data. Also, a model of the B_5H_{11} molecule and the results of the spectra of B_5H_{11} are included. E.E.B.

N65-22871# Liège Univ. (Belgium).
PYROLYSIS STUDIES BY MASS SPECTROMETRY
J. Collin Brussels, EURATOM, 1964 15 p refs Presented at the 12th Ann. Conf. on Mass Spectrometry and Allied Topics, Montreal, 7–12 Jun. 1964
(Contract EURATOM-049-61-12 ORGB)
(EUR-2114.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

The thermal decomposition of biphenyl and ethylnitrite in a quartz furnace has been studied by means of a mass spectrometer. In the case of biphenyl it was found that an appreciable decomposition already occurs around 450° C, in the 30-microns range of pressure, without carrier gas. The C_3H_3 and C_6H_5 free radicals were detected. Possible correlations between observed products and bond orders in biphenyl molecules are considered. As for ethylnitrite, decomposition is already very important at 200° C. Among the products detected were CH_3 radicals in small quantities, ethanol and acetaldehyde. It is shown that a change in reaction occurs around 350° C, probably due to dehydration of ethanol and decomposition of acetaldehyde into methane and carbon monoxide. Author

N65-22872# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
PREPARATION OF LABELLED MOLECULES BY GAMMA IRRADIATION [PREPARATION DES MOLECULES MARQUEES PAR IRRADIATION GAMMA]
R. Constant, C. Fallais, and F. Provoost Brussels, EURATOM, Dec. 1964 32 p refs In FRENCH; ENGLISH Summary
(Contract EURATOM-045-63-11 RISB)
(EUR-2203.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The purpose is to study the marked molecules which appeared during the irradiation γ of the $^{14}CO_2$-$^{14}CH_4$ gas mixture. The influence exercised by various factors such as the CO_2/CH_4 ratio, the irradiation dose, the pressure and the mixture with ^{14}CO on the production of the molecules, is being investigated. The study of the irradiation of the CO_2n butane mixture has been started. The qualitative and quantitative analyses are being carried out by means of gaseous-phase chromatography, mass spectrometry, and the ionization chamber. Author

N65-22874# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
DEVELOPMENT OF A FIRE-RESISTANT WATER-BASE HYDRAULIC FLUID Bimonthly Progress Report, 1 Jan.–28 Feb. 1965
H. F. Lederle 10 Mar. 1965 27 p
(Contract NObs-90268)
(BMPR-5; AD-611879)

Two new base stocks were prepared by alkoxylation of n,n'-diphenyl p-phenylene diamine and p-anilinophenol. These, as well as the previously reported base stocks, required viscosity index improvers and pour point depressants in order to meet the 25° F viscosity maximum of 850 cs and the pour point maximum of 0° F. Four formulations having the best overall properties were selected for final formulation and evaluations. The reproducibility of base stock preparation was investigated and, with one exception, was found to be satisfactory. Author

N65-22952# Korad Corp., Santa Monica, Calif.
INORGANIC LASER MATERIALS Interim Engineering Report, 1 Aug.–30 Nov. 1964
Wright-Patterson AFB, Ohio, AF Avionics Lab., 21 Dec. 1964 57 p refs
(Contract AF 33(615)-1967)
(AD-611416)

A study on the improvement of the crystal quality and performance efficiency of two host unary oxides Gd_2O_3 and La_2O_3, and an evaluation of $GdAlO_3$, $MgO \cdot Al_2O_3$, and $BeO \cdot Al_2O_3$ as laser hosts are presented. Hybridized growth techniques were also studied in order to cope with the manifold problems associated with crystal growth of polynary oxides. Emphasized in the study on the improvement of crystal quality and size are two phases aimed at (1) the attainment of a higher level of purity in the starting material, and (2) the attainment of a favorable heat balance which can be maintained under a steady-state condition of growth through a time interval commensurate with the size of crystal desired. A cation exchange purification method was developed for the removal of rare earth impurities. Studies are reported on the use of this method and other procedures in the separation of the most common impurities in Gd_2O_3. In conjunction with the second phase, boules were grown (undoped powder), 1/4 O.D., for heat balance study and acquaintance with problems pertaining to the annealing of specimens on site. Results of these studies are also reported. Spectroscopy, synthesis, crystal growth, and sorption/deterioration data are presented for the two host unary oxides and the host binary oxides. S.C.W.

N65-22957# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
[MECHANISMS OF OXIDATION AND ADSORPTION OF HYDROCARBONS ON NOBLE METALS AND THEIR ALLOYS] Interim Technical Progress Report, 7 Feb.–6 Nov. 1964
E. Gileadi, B. Piersma, A. Damjanovic, and B. Rubin Jan. 1965 108 p refs
(Contract DA-44-009-AMC-469(T))
(AD-612252)

The potential, concentration, and temperature dependence of the adsorption of ethylene on a platinized gold electrode were investigated. The familiar bell-shaped potential-coverage relationship was observed with the peak potential at 0.46 V (extrapolated to $\theta = 0$). The peak potential shifts slightly in the cathodic direction with increasing coverage. The equilibrium constant for adsorption is essentially independent of temperature from 30° to 70° C. This leads to $\Delta H^{\circ}_{ads} \doteq 0$, as compared to a heat of adsorption of −58 Kcal/mole in the gas phase. The difference is explained quantitatively by considering adsorption as a replacement reaction. Four water molecules are assumed replaced by each ethylene molecule. A positive standard entropy of adsorption observed is consistent with the water displacement mechanism. The rate of adsorption is shown to be diffusion controlled. The equilibrium constant obtained from diffusion measurements agrees with that obtained from the isotherm. Author

N65-22960# Los Alamos Scientific Lab., N. Mex.
THE X-RAY ABSORPTION EDGE DETERMINATION OF PLUTONIUM IN URANIUM–PLUTONIUM–MANGANESE ALLOYS
R. G. Hurley, E. A. Hakkila, and G. R. Waterbury 7 Apr. 1965 14 p refs
(Contract W-7405-ENG-36)
(LA-3258) CFSTI: $1.00

Plutonium in uranium–plutonium–manganese alloys is determined using an X-ray absorption edge method in which the intensities of the secondary X-rays of niobium and molybdenum transmitted through the sample solution are measured. These secondary X-rays are generated by irradiating a niobium–molybdenum metal target with X-rays from a tungsten-target X-ray tube and are transmitted through an absorption cell filled successively with water, suitable standards, and the sample solution. The L III absorption edge for plutonium at 0.686 Å occurs between the $K\beta_1$ line for niobium and the $K\alpha$ line for molybdenum at 0.666 and 0.710 Å, respectively. Measured transmitted intensities of these lines are related to plutonium concentrations using accepted absorption principles. The method is applicable to the determination of plutonium concentrations in the range between 30% and 100% with relative standard deviations in the range between 0.91% and 0.55%. Only radon, radium, neptunium, and americium have absorption edges between the X-ray lines used for analysis and cause interference. Author

N65-23026# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Chemie
ACTIVATING-ANALYTICAL PROOF OF TRACER ELEMENTS IN POLYETHYLENE [AKTIVIERUNGSANALYTISCHER NACHWEIS VON SPURENELEMENTEN IN POLYATHYLEN]
H. Sorantin and P. Patek [1964] 34 p refs In GERMAN Submitted for Publication
(SGAE-CH-9/1964)

Nondestructive neutron-activating analyses of low and high pressure polyethylenes were performed by irradiation at 2×10^{12}n $cm^{-2}sec^{-1}$ for short exposure and at 6×10^{13}n $cm^{-2}sec^{-1}$ for long exposures. The observed γ-spectra were compared to similar treated standards for possible quantitative evaluation. The quality and some of the quantities of 17 impurity elements were determined and are presented in a table. Quantitative differences in single probes of the same source were not obtainable because the consistency of the measured values did not exceed 10%. Visual observation of the high impurity low pressure polyethylenes showed color changes after 5-min irradiation; purer high pressure polyethylenes showed changes only after 1-hr irradiation. Transl. by G.G.

N65-23032# Princeton Univ., N. J.
RESEARCH ON DIELECTRIC PROPERTIES AND THE STRUCTURE OF MATTER Annual Summary Report, 1 Oct. 1963–30 Sep. 1964
Charles P. Smyth [1964] 8 p refs
(Contract Nonr-1858(09))
(AD-610999)

Measurements of dielectric constant and dielectric loss over a wide range of frequencies were used to investigate problems of the organic solid state, of liquid structure, and of molecular structure. The dielectric behavior of several long chain molecules in solid solution in n-hexacosane, $C_{26}H_{54}$ was investigated. Measurements at centimeter wavelengths, combined with measurements at 1.2 cm and 2.2 mm, showed that in several binary mixtures of polar liquids, the individuality of the molecules is retained and the process of dielectric relaxation is molecular rather than one involving larger regions of the liquids. Measurements at one or two wavelengths for eight rigid molecules showed that the ultra high-frequency dispersion region is nonexistent. Optical dielectric constants and atomic polarizations were obtained for these and seven additional liquids. New measurements of dielectric constant and loss at 16 wavelengths from 0.22 cm to 30000 cm on 10 straight chain alcohols confirmed the existence of 3 dielectric dispersion regions. Improved values for the relaxation times of the second and third regions indicate that intermediate relaxation time is for overall rotation of monomeric molecules, and the short relaxation time is for intramolecular rotation of the OH group. Other investigations on relaxation time are discussed. S.C.W.

N65-23035# Leicester Univ. (England). Dept. of Chemistry
A STUDY OF ION–ION AND ION–SOLVENT INTERACTIONS Final Report, Jan.–Dec. 1964
M. C. R. Symons [1964] 19 p refs
(Contract DA-91-591-EUC-3195)
(AD-458819)

Ultraviolet absorption spectra of halide ions in solution, charge-transfer-to-solvent spectra, are discussed using a simple confined model for the electron in the excited state. Similarities between this model and that for the ground state of both solvated electrons and F centers are noted. Reviewed are properties of solvated electrons in condensed and fluid media as indicated by absorption and electron spin resonance spectra. Aqueous alkali–metal hydroxide glasses after exposure to γ-radiation at 77° K are characterized by an intense absorption band at about 17000 cm^{-1}, lost on exposure to visible light. Comparison of the electron resonance spectra before and after bleaching suggests that the blue species is paramagnetic, having a symmetrical absorption band of width about 14 gauss and a g-factor of 2.000. The nature of this species is discussed; it is postulated that the entity is an electron trapped at a hydroxide vacancy. Effect of added halide ion on the electron resonance spectra was examined. A second species, having $g = 2.002$ and $g = 2.07$ is discussed in terms of an O^- radical perturbed by the medium. Evidence that solvated electrons are strongly confined to cavities in

the solvent is summarized; a simple model suggested links the optical properties of solvated electrons to those of F centers in alkali-halide. Author

N65-23036# Aeronutronic, Newport Beach, Calif.
ABSORPTION BY CO_2 BETWEEN 4500 AND 5400 cm^{-1}
Darrell E. Burch, David A. Gryvnak, and Richard R. Patty 15 Dec. 1963 141 p
(Contract Nonr-3560(00); ARPA Order 237)
(U-2955; AD-609931)

The absorption by 38 different samples of CO_2 in the 4500 to 5400 cm^{-1} (near 2 microns) region was studied with the use of a spectrometer having a spectral resolution between approximately 0.3 and 1 cm^{-1}. Samples of CO_2 and $CO_2 + N_2$ were contained in two different absorption cells; one having a maximum path of 933 meters and used at a maximum pressure of 2.5 atm. The other was used at paths as long as 32.9 meters and at pressures as high as 15 atm. Photographs of the spectra of every sample as well as a table of transmittance versus wavenumber are included. Also presented is a table of the integrated absorptance

$$\int_{\nu_1}^{\nu_2} \left[1 - T(\nu)\right] d\nu$$

versus ν, where approximately 600 values are tabulated for the largest samples. Author

N65-23055# Chicago Univ., Ill. Labs. for Applied Sciences
APPLICATION OF ALPHA-PARTICLE SCATTERING TO CHEMICAL ANALYSIS Final Report
R. A. Semmler, J. F. Tribby, and J. E. Brugger Oak Ridge, Tenn., AEC, Oct. 1964 91 p refs
(Contract AT(11-1)-712)
(COO-712-89) CFSTI: $3.00

The application of elastic backscattering of low energy (6.1 MeV) alpha particles to the chemical analysis of surface layers and thin-film samples is examined. The sensitivity for light elements is greater than predicted from classical Rutherford scattering because of resonance scattering effects. Using a 1-Mc alpha source, the minimum detectable thickness density for most elements is 2–10 $\mu g/cm^2$ using sample areas of about 4 cm^2 and counting times of 1000 minutes. Carbon is exceptional in that 0.2 $\mu g/cm^2$ can be detected. Author

N65-23057# Argonne National Lab., Ill. Chemical Engineering Div.
ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 5: DESCRIPTION OF A PILOT-SCALE FACILITY FOR URANIUM DIOXIDE-PLUTONIUM DIOXIDE PROCESSING STUDIES
G. J. Vogel, E. L. Carls, and W. J. Mecham Dec. 1964 78 p refs
(Contract W-31-109-ENG-38)
(ANL-6901) CFSTI: $3.00

A pilot plant was constructed for studying the following two major process steps, as applied to uranium dioxide-plutonium dioxide fuel: (1) the fluorination of uranium and plutonium oxides to hexafluorides, and (2) the conversion of uranium and plutonium hexafluorides to dense dioxide mixtures suitable for refabrication of fuel. The major objective of this facility is the demonstration of optimum process conditions for these two steps for synthetic reactor fuel compositions, including those containing mixtures of inactive fission products. The conversion unit can also be used for separating uranium and plutonium by selective reduction of plutonium hexafluoride from hexafluoride mixtures. The nominal throughput of the pilot plant is 10 kg/day. Special features of the general layout and alpha containment, fluorinator system, and converter system are described. Recommended specifications for fabrication and inspection of nickel process vessels are included. S.C.W.

N65-23061*# Yardney Electric Corp., New York.
RESEARCH AND DEVELOPMENT OF THE SILVER OXIDE-CADMIUM ELECTROCHEMICAL SYSTEM First Quarterly Progress Report, 10 Nov. 1964–9 Feb. 1965
Allen Charkey [1965] 49 p
(Contract NAS5-9106)
(NASA-CR-62486) CFSTI: HC $2.00/MF $0.50

A program designed to investigate electrode reactions which occur in sealed silver oxide–cadmium cells and to study methods for improving the system for spacecraft use, is reported. Two sealed cells which use a nylon–dynel interseparator in combination with three turns of Visking cellulose main separator completed 1000 shallow cyles (35% DD) and are still operating at about 78% original capacity. The effect of temperature on voltage and capacity was investigated over the range of +40° to −10° C on both silver and cadmium electrodes. Little difference in performance was found above 10° C. At −10° C the discharge capacities for both electrodes decreased sharply by about 50%. The effect of density on performance of the negative electrode was not significant at any temperature studied. A study to improve the material utilization of the negative electrode is also reported. Increasing the surface area of CdO powder from 1.5 to 4.5 m^2/g increased cadmium utilization from 63% (theoretical) to 75% during initial cycles. Increasing internal cell pack pressure decreased cadmium utilization, while increasing the grid area had little effect on performance. Single negative electrodes were dummy cycled in electrolytes containing the oxidized solubles of either C-19 or PVA to study the effect of separation debris on performance. About 15% less capacity is obtained in cells containing separator debris, as compared to cells containing clean electrolytes. Several cells which feature support cadmium electrodes in a silver matrix were constructed. Their performance, after several deep cycles, is comparable to standard cadmium impregnated nickel electrodes. S.C.W.

N65-23064*# Georgia Inst. of Tech., Atlanta. School of Chemical Engineering
MASS SPECTROMETRIC STUDIES AND CRYOGENIC REACTIVITY OF CF_2 AND C_2
William Joseph Martin (Ph.D. Thesis) Mar. 1965 133 p refs
(Grant NsG-123-61)
(NASA-CR-62472) CFSTI: HC $4.00/MF $1.00

The generation of CF_2 by pyrolysis of various parent compounds, the identification and study of this molecule by mass spectrometer, and the study of the reactivity of CF_2 at cryogenic temperatures are discussed. Many parent compounds were pyrolyzed under a variety of conditions, and the highest concentration of CF_2 was produced by the passage of CF_3I over a heated platinum filament. The results of all of the pyrolysis experiments are presented in table form. The ionization potentials of some of the parent compounds and the appearance potentials of a number of the fragment ions were measured and are shown. The most important result is the previously unknown ionization potential of CF_2. The complete low-resolution spectra obtained are presented, the mass spectra of several compounds were recorded at various temperatures, and the relative intensities of their peaks are given. Investigated were: CF_3I; $CF_2ClCOOH$; Cyclo-C_4F_8; $CHClF_2$; CF_2CFCl; C_2I_4; CHI_3; and low temperature quenching with CF_2. G.G.

N65-23090# Harvard Univ., Cambridge, Mass. Mallinckrodt Chemical Labs.
MICROWAVE SPECTRUM, STRUCTURE, DIPOLE MOMENT, AND QUADRUPOLE COUPLING CONSTANTS OF 1, 2, 5-OXADIAZOLE
A. P. Cox and E. Saegebarth [1963] 32 p refs
(Contract Nonr-1866(14))
(AD-612293)

Microwave spectra of the normal species ($C_2H_2N_2O$) and the $C^{13}CH_2N_2O$, $C_2H_2N^{15}NO$, $C_2D_2N_2O$, and C_2HDN_2O isotopic species of 1,2,5-oxadiazole have been assigned. Value of the inertial defect indicates a planar structure for the molecule. The structural parameters obtained from the isotopic changes in the moments of inertia plus the center of mass condition, $\sum_i m_i b_i = 0$, are these:

O—N = 1.380 ±0.003 Å, C=N = 1.300 ±0.003 Å, C—C = 1.421 ±0.003 Å, C—H = 1.076 ±0.003 Å, <NON = 110° 24′ ±20′, <ONC = 105° 49′ ±20′, <CCN = 108° 59′ ±20′, <CCH = 130° 10′ ±35′, <NCH = 120° 51′ ±35′.

Stark effect measurements gave a dipole moment of 3.38 ±0.04 D. The nitrogen quadrupole coupling constants of the normal species were determined from an analysis of the hyperfine splittings of four low J Q-branch lines to be $\chi_{aa} = -0.69$ ±0.09 Mc/sec., $\chi_{bb} = -0.46$ ±0.13 Mc/sec., and $\chi_{cc} = 1.15$ ±0.04 Mc/sec. These constants correctly predict the shape and splitting of an additional low J R-branch line. The absence of a low lying vibrationally excited state, the absence of an out-of-plane component of the dipole moment, and the relative intensities of the quadrupole components of the lines of $C_2H_2N_2O$ and $C_2D_2N_2O$ are further evidence for the planarity and C_{2v} symmetry of the molecule. Author

N65-23104# Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION C STATUS AND PROGRESS REPORT ON SEPARATIONS RESEARCH AND DEVELOPMENT
K. B. Brown Apr. 1965 188 p refs
(Contract W-7405-ENG-26)
(ORNL-3785) CFSTI: $5.00

Work was done in the following areas: *Fractionation of Transfer-Ribonucleic Acids; Cesium Recovery from Ores; Sorption of Uranyl Ion by Phosphine Oxide Immobilized in Granules of Microporous Polyethylene; Stability of Aliphatic Diluents After Treating with Sulfuric Acid; Screening of Organonitrogen Compounds; Extraction of Metals from Chloride Solutions with Amines; Uranium and Thorium Extraction with Caged-Phosphate Compounds; Organic-Soluble Neutron Poison; Extraction of Alkali Metals by Substituted Phenols; Isopiestic Investigation of 4-sec-butyl-2-(α-methyl-benzyl)-phenol Polymerization in Various Diluents; Synergistic Effects of Carboxylic Acids and Di(2-ethyl-hexyl)phosphoric Acid on Extraction of Cesium by 4-sec-butyl-2-(α-methylbenzyl)phenol; Organic-Phase Activity Coefficients: Triphenylmethane, Azobenzene, and Tri-n-Octylamine in Dry Benzene; Comparison of Glass-Electrode pH with Quinhydrone Electrode Potential in 4 Molar Sodium Nitrate Medium;* and *Investigation of Possible Intermolecular Bonding in Some Mixtures of Phosphate Extractants by Dielectric Measurements.* G.G.

N65-23124# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
DIFFUSION STUDIES IN REFRACTORY MATERIALS Summary Report, 1 Mar. 1964–28 Feb. 1965
B. J. Wuensch and T. Vasilos [1965] 21 p refs
(Contract Nonr-4267(00))
(AD-611813)

The effects of imposed stress and the presence of grain boundaries on diffusion rates in magnesium oxide is described. Loads of up to 5000 psi on samples placed in four-point loading do not appear to influence the rate of diffusion of Ni^{2+} in single-crystal MgO in the temperature 1000° to 1300° C. Grain-boundary diffusion of Ni^{2+} and Co^{2+} was observed in isolated grain boundaries in MgO bicrystals. The effect appears to be due to segregation of impurities, principally Ca^{2+} and Si^{4+}, at the boundary, and is not an intrinsic property of the grain boundary. Data for the diffusion of Zn^{2+} in MgO were obtained, and may be described in terms of an activation energy of 1.85 electron volts and a value of D_o of 1.48 10^{-5} cm^2/sec. Author

N65-23126# Bureau of Mines, Washington, D. C.
CRYSTALLOGRAPHIC MODIFICATIONS AND PHASE TRANSFORMATION RATES OF FIVE RARE-EARTH SESQUIOXIDES: LANTHANUM OXIDE, NEODYMIUM OXIDE, SAMARIUM OXIDE, EUROPIUM OXIDE, AND GADOLINIUM OXIDE
Stephan Stecura 1965 49 p refs
(BM-RI-6616)

Crystallographic modifications and kinetics of solid-state phase transformations were determined for five rare-earth sesquioxides—La_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3, and Gd_2O_3. Oxides used for crystal modification studies were prepared by thermal decomposition of the following high-purity salts of the five rare-earth elements—carbonates, chlorides, fluorides, nitrates, oxalates, and sulfates. The X-ray diffraction patterns of the cubic and hexagonal oxides were indexed by a graphical method and patterns of the monoclinic oxides by Ito's method. The kinetics of crystallographic transformation was determined by high-temperature X-ray diffractometry. The kinetic data were interpreted using a shrinking sphere model. All of the transformations followed first-order kinetics. Activation energies were calculated by application of the Arrhenius equation. These solid-state phase inversions were concluded to occur by a reconstructive transformation mechanism. Author

N65-23133# United States Rubber Co., Wayne, N. J. Research Center
PHOSPHONITRILIC POLYMERS STABLE AT HIGH TEMPERATURES Quarterly Report, 1 Nov. 1964–31 Jan. 1965
Harold K. Garner, Gerald J. Klender, Aspet Merijanian, and Douglas I. Relyea 18 Feb. 1965 26 p refs
(Contract NObs-92060)
(QR-1; AD-612271)

The objective is the development of new thermoplastic and thermosetting resins from phosphonitrilic chloride trimer for high temperature electrical applications. The preparation of the tetraphenoxydichlorophosphonitrile trimer was scaled up to yield a total of 7 pounds of this monomer. Additional quantities of other monomers were also prepared. Copolymerization of phosphonitriles of reduced functionality was carried out to give polymers containing the bridging groups —O—, p,p′—$OC_6H_4OC_6H_4O$—, and p,p′—$OC_6H_4C(CH_3)_2C_6H_4O$—. The introduction of the borate function onto the trimeric phosphonitrile ring was carried out. Author

N65-23134# Ohio State Univ. Research Foundation, Columbus.
TOTAL ABSORPTANCE OF NO NEAR 5.3μ USING N_2 AS A PRESSURE BROADENING GAS Scientific Report No. 1

Dale Leroy Ford Dec. 1964 44 p refs
(Contract AF 19(628)-3806)
(AFCRL-64-1023; AD-612176)

Spectra of the 5.3μ band of NO were obtained using a double beam prism spectrometer. The total absorptance of the band was determined for NO concentrations of 0.004 to 5.4 atm cm and pressure broadened by N_2 up to 2100 mm of Hg. Three cells were used with lengths of 1.55, 2.54, and 6.35 cm. The average broadening coefficient of NO relative to N_2 was determined to be 1.00 ±0.05. The band intensity was determined to be 115 $atm^{-1}cm^{-2}$ S.T.P. ±10%. Author

N65-23156# Union Carbide Plastics Co., Bound Brook, N. J.
RESEARCH ON IMPROVED EPOXY RESINS
D. P. Norris, R. F. Sellers, and S. G. Smith 1 Feb. 1964 39 p
(Contract Nonr-4172(00))
(AD-430360) CFSTI: $1.00

The purpose is to define the correlation of novel diepoxide molecular configurations with the physical properties of cast resins as the initial step in providing significant improvements in filament reinforced plastics for deep submergence structures. A discussion of the relationship of physical properties to molecular configuration and to the relative purity of representative sample resins is presented as interpreted from cast resin data obtained from diepoxides. Progress on the preparation of novel diepoxides to be tested is described. Author

N65-23158# Astrosystems International, Inc., Fairfield, N. J.
RESEARCH AND DEVELOPMENT PROGRAM TO THE FEASIBILITY OF A HIGH INTENSITY SOUND GENERATOR: ENERGY PRODUCED BY PROPANE-AIR DETONATIONS IN A TUBE Final Report, Jan. 1963–Feb. 1964
A. J. Schwalb 10 Apr. 1964 26 p
(Contract ARPA SD-169)
(TR-63002-F1)

An aerothermochemical model of one-dimensional steady nondissipative flow in a homogeneous combustible mixture was analyzed to determine the thermodynamic, gas dynamic, and chemical properties produced behind moving detonation waves generated by the reaction of hydrocarbon fuels with oxidizers. The reactant gas conditions were specified from the known thermodynamic state and chemical composition. The ensuing reactions with oxygen and air are indicated by the chemical equations, for the 16 gas species produced. The number of moles of each of the 16 produced gas species as well as the detonation product flow variables are then determined by a system of 19 equations considering species, mass, momentum, and energy conservation, heat reaction, and energy release. The end results for the stoichiometric reactant composition

$$C_3H_8 + 5O_2 + 18.6N_2 + 0.22\ A_r$$

detonated under normal atmospheric conditions are presented in tables. G.G.

N65-23210*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
STUDY OF THE GROWTH PARAMETERS INVOLVED IN SYNTHESIZING BORON CARBIDE FILAMENTS Second Quarterly Report
A. Gatti and C. Mancuso Dec. 1964 21 p refs
(Contract NASw-937)
(NASA-CR-62591) CFSTI: HC $1.00/MF $0.50

It was discovered that the element molybdenum, in addition to vanadium, would enhance the yield and size of individual B_4C whiskers. Powder additions of molybdenum, when added to exhausted B_4C powder (powder which would no longer grow whiskers), also showed an equal or better growth of B_4C whiskers than the best B_4C bulk powder used to date using the pure vapor method. Geometric studies have also added to B_4C whisker growth technology. Whisker growing processes, in general, produce only small volumes of usable whiskers for a given run. Thus, additives which can increase whisker yields are most useful. The geometric changes made in the whisker growth chamber resulted in greater than an order-of-magnitude increase in whisker yield. Author

N65-23235# Hanford Atomic Products Operation, Richland, Wash. Chemical Lab.
SOLIDIFICATION OF HIGH-LEVEL RADIOACTIVE FUEL REPROCESSING WASTES BY SPRAY AND POT CALCINATION—HOT-CELL PILOT PLANT STUDIES
R. T. Allemann, F. P. Roberts, and U. L. Upson Sep. 1964 93 p refs
(Contract AT(45-1)-1350)
(HW-83896) CFSTI: $4.00

Calcination of full level Purex and Redox waste was carried out successfully in a remotely operated pilot plant consisting of a radiant-heat spray calciner and a pot calciner and their associated offgas equipment. Behavior of fission products under calcination conditions was studied as a function of feed additives and offgas equipment. Ruthenium was most difficult to control because of its volatility. Its normal release of 20% with acidic wastes was reduced to 3% by adding reducing agents. With neutral or basic wastes and reducing agents ruthenium did not volatilize significantly more than other fission products. Amount of ruthenium volatilized was relatively unaffected by the type of calciner used. Decontamination factors from feed to offgas of 10^8 to 10^9 could be obtained by use of only a condenser and high-efficiency filter in the offgas train. Achieving a desired melt was difficult because of analytical error and loss of sulfate. Excess sulfate caused corrosion in some sampling valves and in the spray calciner shell. Fission product release during pot calcination increased throughout the runs until final dry-down and calcination. With excess sodium in waste, loss of cesium increased during pot calcination. Calcined waste containers without excess sodium nitrate developed no excess pressure upon storage. Fission product distribution in the melted wastes was uniform and in the same ratio as in liquid waste except for ruthenium losses. Author

N65-23239# Los Alamos Scientific Lab., N. Mex.
SOLID SOLUTION CARBIDES OF URANIUM AND ZIRCONIUM
K. V. Davidson, R. E. Riley, and J. M. Taub 30 Mar. 1965 36 p
(Contract W-7405-ENG-36)
(LA-3217) CFSTI: $2.00

This report includes a summary of various chemical reaction techniques used for the production of $(UC)_x(ZrC)_y$ powder, and the processes used to prepare intermediate raw materials used in certain of these techniques. Also reported are the results of analytical evaluations of the quality of the product prepared by each technique. A detailed account is given of the arc-melting of elemental constituents and of the subsequent thermal treatments used to remove extraneous phases. Analytical results are reported for the powders produced from arc-melted buttons, showing the reproducibility attainable by this procedure. Author

N65-23258# Stanford Research Inst., Menlo Park, Calif.
OXIDATION OF UNSATURATED HYDROCARBONS Final Report, Oct. 1, 1961–Sep. 30, 1963

Dale E. Van Sickle and Franc R. Mayo 10 Jan. 1964 8 p ref
(Contract AF 49(638)-1102)
(AD-429761)

Effort was directed toward product studies of low temperature, liquid-phase olefin oxidations. Pure hydrocarbons were utilized where possible, azo initiators employed, and conversions limited to 5%. The hydroperoxide produced was correlated with the remaining products found; relative rates were assigned for the two chain propagation reactions, hydrogen abstraction reaction and addition reaction. A secondary effort was the study of autocatalysis in oxidation. Cyclopentene was chosen as a model compound, since its oxidation mechanism is the simplest of the olefins studied. Decomposition and initiating properties of hydroperoxides also received attention. Author

N65-23268# International Union of Pure and Applied Chemistry, Basle (Switzerland).
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, JANUARY, FEBRUARY, MARCH 1965, VOLUME 1965, NUMBER 1
J. J. Diamond, ed. (NBS, Washington, D. C.) [1965] 60 p refs

N65-23272# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
CALCULATION OF THE VAPOR PRESSURE AND HEATS OF VAPORIZATION AND SUBLIMATION OF LIQUIDS AND SOLIDS, ESPECIALLY BELOW ONE ATMOSPHERE. V. CARBON MONOXIDE AND CARBON DIOXIDE
J. C. Mullins, B. S. Kirk, and W. T. Ziegler 15 Aug. 1963 89 p refs
(Contract NBS CST-7404)
(TR-2)

The vapor pressure and heats of vaporization and sublimation of carbon monoxide were computed at one degree intervals from the normal boiling point (81.638° K) to 14° K. The vapor pressure and heats of sublimation of carbon dioxide were computed at one degree intervals from the normal sublimation temperature (194.694° K) to 40° K. The agreement obtained between the computed and experimental vapor pressure data for carbon monoxide in the liquid and solid region down to the solid transition point (61.544° K) suggests that the computed values may represent the experimental data within the accuracy of the temperature scales used. The computed values of the vapor pressures are recommended for use as smoothed values, especially below the solid transition temperature where the limited experimental data are scattered and discordant. For carbon dioxide the computed values of the vapor pressures agree well with the best experimental data obtained on the thermodynamic scale. The experimental data measured on the International Temperature Scale appeared to deviate consistently with the available known deviations of the International Temperature Scale from the thermodynamic scale. The values of the vapor pressure of carbon dioxide computed at one degree intervals are therefore recommended as a consistent set of values on the thermodynamic temperature scale. Author

N65-23293# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
STABILITY CONSTANTS OF THE TRIVALENT LANTHANONS WITH SOME ALPHA-HYDROXYCARBOXYLIC ACIDS
George S. Paul and Jack E. Powell Feb. 1965 85 p refs
(Contract W-7405-ENG-82)
(IS-1122) CFSTI: $3.00

The first three stepwise formation constants of the 2-hydroxy-3-methylbutanoate (isopropylglycolate), 2,3-dimethyl-2-hydroxybutanoate (methylisopropylglycolate), 3,3-dimethyl-2-hydroxybutanoate (tertiary-butylglycolate), and 2-hydroxy-2,3,3-trimethylbutanoate (methyltertiary-butylglycolate) complexes of the trivalent rare earths and yttrium were determined at 25°C and an ionic strength of 0.1 molar ($NaClO_4$). The stabilities of the complexes followed the ionic radius trend quite regularly and generally decreased with increasing complexity of the alkyl substituents on the ligand, but replacing a hydrogen atom by a methyl group invariably enhanced the stabilities of the complexes, especially in the case of the heavier, smaller rare-earth ions. It was postulated that the stabilities of the heavier rare-earth complexes with the methyl-substituted homologues were enhanced because of a smaller, more favorable hydroxyl–carboxyl bond angle. Author

N65-23298# Linden Labs., Inc., State College, Pa.
MACHINING HIGH PURITY ALUMINA First Quarterly Report, 28 Jun.–30 Sep. 1964
P. A. Marshall, Jr. and J. M. Infield 30 Sep. 1964 34 p
(Contract DA-36-039-AMC-03634(E))
(Rept.-1; AD-609951)

Machining high purity polycrystalline alumina by prior treatment with HF and the study of commercial samples of high purity polycrystalline alumina are discussed. The study covers rate of penetration of the acid into the alumina and also investigated the machine tool wear produced by turning the sample in a lathe. Reconstitution firing temperatures and the problems evident at this stage are discussed. All the samples, after reconstitution, were porous to the organic dye test, and a recrystallization was noted on the surface of the ceramic. Dimensional stability of the treated alumina before and after reconstitution is covered. Reported also are the preparation of the area for fluorination of the engineering phase pieces and some precautionary measures built into the area. Author

N65-23322# National Bureau of Standards, Washington, D. C.
PHOTOCHROMISM AND PHOTOTROPISM
Nov. 1964 13 p refs
(QTR-103) CFSTI: $0.50

This project involved the fields of photochromism and phototropism. Most of this R&D has been concentrated in the visible, near-infrared, and ultraviolet ranges of the spectrum. Basic research in these fields has been oriented toward elucidating the reaction mechanisms of these compounds. Applied research programs have resulted in the synthesis of new reactive materials and new improved concepts for application of reversible systems. Possible uses of these systems include eye-protective devices, optical memory devices in computers, and modulating or monitoring light valves. Author

N65-23325# California Inst. of Tech., Pasadena. Gates and Crellin Labs. of Chemistry
STEREOCHEMICAL ASPECTS OF THE DIELS–ALDER REACTION
Joseph B. Lambert and John D. Roberts Jan. 1965 8 p refs Submitted for Publication *Its* Contribution No. 3210
(Contract Nonr-220(26))
(TR-37; AD-457082)

In the Diels–Alder reaction of hexachlorocyclopentadiene and α-methylstyrene, the *cis-trans* ratio of deuterium in the β-position of the alkene remains unchanged in the adduct. The reactions of *cis-* and *trans*-1,2-dichloroethylene with cyclopentadiene have been found to be at least 99.5% stereospecific.

Since these systems were designed to favor the diradical intermediate which might be involved in a two-step mechanism, the observed high degree of specificity is best accounted for on the basis of a concerted, one-step mechanism. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-22227# Naval Missile Center, Point Mugu, Calif. Advanced Weapons Div.

EXPERIMENTAL MODEL OF THE STOCHASTIC PROCESSES ASSOCIATED WITH AIR-TO-AIR COMMUNICATIONS OVER SEA WATER (VERTICAL POLARIZATION)

Richard Lane 18 Feb. 1965 98 p refs
(NMC-MP-65-2; AD-611280)

Only the interaction of the field with the surface, specifically sea water, is considered. The starting point of this analysis is the reflection coefficient, rather than the surface irregularities, because it is a parameter in the field equation and because it was anticipated that experimental data of the reflection coefficient could more easily be obtained than data on the surface irregularities. Further, the reflection coefficient is the terminal point of a compound stochastic process and hence by studying the reflection coefficient, the overall problem is simplified. Probability laws of the stochastic process for the magnitude of the reflection coefficient and the field at the receiving antenna are derived from the experimental data available. Use of the beta distribution for the reflection coefficient data is considered in detail because a flexible distribution is needed to describe the experimental data. However, lack of sufficient experimental data precludes any definite statement concerning the value of the new approaches. Author

N65-22232# Naval Research Lab., Washington, D. C. Radio Div.

PRECISION MEASUREMENT OF VHF GAIN AND POINTING ACCURACY OF THE NRL 150-FOOT PARABOLIC ANTENNA

P. F. Nicholson 13 Jan. 1965 20 p refs
(NRL-MEMO-1587; AD-612147)

Radio astronomy techniques were employed by accurately determining the gain, pointing error, and temperature of the CBA, NRL 150-foot parabolic antenna system. A frequency of 146 mhz was chosen for measurements corresponding to one of the few 4-mhz-wide channels in the mid-vhf spectrum free from commercial transmitters. The power gain at this frequency was measured as 34.9 dB corresponding to an efficiency of 63% and evidenced a high performance antenna system for its class. This result also corroborated predictions of photogrammetric studies and other calibration checks on the dish. The pointing error was found to be 0.08 degrees, which was well within the tolerance specified by the beam width at this frequency. Antenna temperature measurements corresponded closely to the expected sky-brightness temperature leading to the conclusion that broadband, manmade, rfi (broadband interference) did not significantly contribute to the continuum background noise. Author

N65-22234# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center

A PRACTICAL HANDBOOK FOR LOCATION AND PREVENTION OF RADIO INTERFERENCE FROM OVERHEAD POWER LINES

W. E. Pakala 8 Oct. 1964 52 p refs
(RR-64-9E4-565-R1; AD-612190)

Many years of experience by utilities have shown that the location of the source of interference and its elimination does not require exact determination of field strengths but rather a technique founded on experience and a knowledge of the past radio interference characteristics of apparatus and pole top line construction. The principal methods of locating interference sources on distribution lines and preventive means of construction and maintenance are covered. The methods outlined will be of use to linemen as an aid in keeping lines free of such interference and will assist in constructing lines properly to minimize the creation of radio interference. E.E.B.

N65-22236# Naval Research Lab., Washington, D. C. Sound Div.

OPTIMIZATION OF THE BACK-TO-FRONT SUPPRESSION AND FREQUENCY BANDWIDTH RELATIONSHIP FOR THREE-DIMENSIONAL ACOUSTIC ARRAYS

M. A. Blizard 12 Feb. 1965 19 p refs
(NRL-6204; AD-612093)

For those three-dimensional arrays whose radiation-pattern function is the product of an end-fire-array-pattern function and a broadside-array-pattern function, a procedure has been developed for optimizing the frequency range vs the back-to-front-suppression relationship. That is, the amplitude coefficient distribution for the array is determined by a Tchebyscheff polynomial technique so that (a) the back-to-front suppression is maximum over a predetermined frequency range or (b) a specified back-to-front suppression is available over a maximum frequency range. Author

N65-22244# American Electronic Labs., Inc., Colmar, Pa.

FUTURE RECEIVER CONTROL TECHNIQUES Final Report

J. Waitkeneus, M. Sonstein, L. Tuttle et al Griffiss AFB, N. Y., RADC, Feb. 1965 99 p refs
(Contract AF 30(602)-3187)
(AEL-63096-5; RADC-TDR-64-493; AD-613072)

A number of experimental component and circuit techniques which are applicable in reducing the effects of high level interference on receivers were developed and evaluated. An experimental receiver covering the frequency change 225 to 400 Mc, incorporating many new RFI reduction techniques was also developed. Areas of research included a band reject filter, capacitor and voltage tuned helical resonators, signal phase cancellation techniques, receiver designs and antenna techniques. The band reject filter and phase cancellation device were designed to be compatible with the R-361A communications receiver and the experimental receiver. The hollow, dielectric rod antenna was developed and investigated as a new approach for control of beam widths and angular location of pattern nulls. Modifications were also incorporated in the R-361A receiver to make it less susceptible to adjacent and to cochannel interference. Author

N65-22248# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.

STANDARD RESPONSE INDICATOR: SOME INVESTIGATIONS INTO A DEVICE FOR DETERMINING THE MINIMUM VISIBLE SIGNAL OF A RECEIVER

Edward Hjort Jan. 1965 41 p refs
(RADC-TR-64-534; AD-612719)

The standard response indicator's (SRI) basic function is to establish a threshold level and to provide an output signal whenever the threshold level is exceeded. Threshold detection is based on making a decision of target or no target at a certain level in the output of a receiver. For visual minimum visual signals (MVS), the detection process is complicated by the addition of random noise to the desired signal. The averaging of this random noise by the repetitive sweep of the oscilloscope and the slow response time of the eye tend to increase and distort the average noise level. The increase in apparent noise level must be overcome by the desired signal in order to become visible to the operator. The SRI eliminates the problem of decision making based on an arbitrary reference level set by the operator. The decision of the SRI is based upon the detection of noise pulses exceeding a threshold (voltage level) in a given period of time. This eliminates most of the effects of random output. A large number of sample periods averaged over an interval of time remove the random effects of the noise as seen by the SRI, and an absolute indication of the presence or absence of the desired signal is obtained. Author

N65-22258# Naval Civil Engineering Lab., Port Hueneme, Calif.
BUILDING MATERIALS FOR ATTENUATING ELECTROMAGNETIC INTERFERENCE
H. A. Lasitter 4 Mar. 1965 35 p refs
(R-359; AD-612149) CFSTI: $1.00

The electromagnetic shielding properties of coke cement materials have been investigated experimentally and theoretically. Calculated and measured values are in close agreement. The conductivity of six samples of coke cement has been determined. Repeated measurements after 19, 29, 30, 32, 33, 36, and 191 days show the effect of aging on the conductivity of coke cement materials. These materials were found to be capable of shielding electromagnetic interference of the type that would emanate from the average administrative building under certain circumstances. Eight types of material available commercially and used as construction material were evaluated as electromagnetic shields. Author

N65-22308 Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
OPTICAL-ELECTRONIC AZIMUTH AND RANGE BETWEEN NON-INTERVISIBLE DISTANT GROUND STATIONS
Emanuel M. Sodano *In* Army Dept. Army Sci. Conf. Proc. Vol. II [1965] p 427–440 refs (See N65-22275 12-34)

The three-dimensional solutions derived for azimuth and range up to 700 miles are virtually all-weather because of their use of electromagnetic distance, nonsimultaneous or undercloud optical observations, and unexacting aerial navigation which allows measurements from different passes to be combined, if insufficient, rather than discarded. Yet the flight pattern eliminates much or all atmospheric data acquisition. For the biaerial procedure small Army-type aircraft are ideal. The methods are therefore more economical, rapid, and accurate than contemporary ones requiring virtually straight flights, simultaneous optical observations, atmospherically stable electromagnetic interferometers, or appropriate satellite passes. Author

N65-22342# Sperry Gyroscope Co., Great Neck, N. Y. Radiation Div.
MULTIPLATE ANTENNA FEED Final Engineering Report
S. Milazzo, J. Lory, and C. Rothenberg May 1964 156 p refs
(Contract AF 19(628)-2966)
(EB-5297-0460; AFCRL-64-422; AD-602444)

This report describes the design of a multiplate antenna feed system which consists of tower- and ground-mounted equipment. The feed illuminates each of 4 elliptical multiplate apertures on the ground, producing a single beam on transmit, and a square cluster of 25 beams on receive. The feed system includes techniques for antenna frequency dispersion correction, sidelobe suppression, and polarization control. Various aspects of the feed design, including multiple-beam networks, dispersion correction filters, radiation patterns, phase-locked loops, signal amplification and processing, duplexing, and equipment packaging are described. Author

N65-22344# Raytheon Co., Wayland, Mass. Advanced Development Lab.
INVESTIGATION OF PHASED ARRAY TECHNIQUES Final Report, Mar. 1962–Dec. 1964
Herbert L. Groginsky and Robert C. Distler Feb. 1965 68 p refs
(Contract AF 19(628)-361)
(AFCRL-65-151; AD-613664)

This report describes a new technique for phasing a receiving antenna array. The method uses an acoustic analog of the antenna array to rebroadcast ultrasonic pressure waves in a transparent liquid medium (water). The contents of the medium are read out with a set of coherent optics. The readout mechanism contains a display which permits the bearing angle, radial velocity and time of occurrence of any target within the coverage region of the antenna array to be obtained. The system permits any number of these to be read out simultaneously, with no further adjustments or variation within the phasing mechanism. This report discusses the operation of the system, the limitations relevant to systems applications, the experimental verification of its basic principles, and a prognosis of the feasibility of extrapolating these techniques to large scale systems. Author

N65-22348# Lincoln Lab., Mass. Inst. of Tech., Lexington.
HAYSTACK CALIBRATION ANTENNA
A. Sotiropoulos and J. Ruze 15 Dec. 1964 19 p refs
(Contract AF 19(628)-500)
(TR-367; ESD-TDR-64-588; AD-611436)

The gain of a horn-reflector antenna with an aperture of 65.30 square feet has been measured over a frequency range of 2.7 to 16.0 Gcps. This report describes the experimental measurements, the data with best-fit curves, and a linear regression analysis which permits confidence limits to be set on the gain estimate. Author

N65-22349# Hughes Aircraft Co., Fullerton, Calif.
PHASED ARRAY STUDY Interim Development Report, 1 Oct. 1964–31 Jan. 1965
26 Feb. 1965 70 p
(Contract NObsr-89427)
(FR-65-14-36; AD-611582)

A high yield of 5.0 picofarad diodes having breakdown voltages in the 500 to 800 volt range were produced and assembled into the diode phase shifter modules. These diodes were found to be capable of operating to a peak power level of 6 kilowatts in reverse bias before high level limiting begins. The 1000 volt diodes will increase the peak power level to 10 kilowatts. In forward bias the diodes were tested to 66 kilowatts, with no change in characteristic. The high average power capability of large area diodes was demonstrated by operating up to an average power level of 220 watts with no change in performance. The rms phase errors of the phase shifters through all 16 steps were less than 4° and the loss for several phase shifter modules was 2.0 dB which included 1.0 dB

circuit loss. Using similar high cutoff frequency diodes in conjunction with a low loss package will produce an S-band diode phase shifter with less than 1.5 dB loss. The measured array patterns of the 10 element antenna array with phase shift modules have clearly proved the capability of the diode phase shifters to perform beam scanning within a = 60 scan range. TAB

N65-22387# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
INVESTIGATIONS OF ADVANCED ANALOG COMMUNICATIONS TECHNIQUES Technical Report, 23 Dec. 1963–23 Dec. 1964
Harold D. Becker, Ting T. Chang, and John G. Lawton Griffiss AFB, N.Y., RADC, Mar. 1965 85 p refs
(Contract AF 30(602)-3317)
(CAL-CM-1895-S-1; RADC-TR-65-81; AD-613703)

This report presents the results, obtained by analytical investigations and by computer simulation, of studies of advanced techniques upon which the design of improved analog communication systems may be based. It includes the derivation of the optimal operations to be performed in the least mean-square error estimation of the modulation function in an FM communications system. Relationships between phase-locked loop demodulation and maximum-likelihood estimation of angle-modulated signals are developed. It is shown that a physically realizable phase-locked loop followed by an infinite-delay linear filter can perform the operations specified for the infinite-delay maximum likelihood estimator, phase-locked loop demodulators for both PM and FM modulated signals are analyzed by the quasi-linearization technique. It is shown that analog computer simulation of phase-locked loop demodulators based on low frequency equivalent circuits, which contain a sinusoidal nonlinearity, is a practical means for the investigation of such nonlinear systems. The improvement in system performance which may be attained by simultaneous use of pretransmission and postdetection filtering is examined. Author

N65-22395# Arizona Univ., Tucson. Engineering Research Labs.
AN EXPERIMENTAL STUDY OF PLASMA SHEATH EFFECTS ON ANTENNAS Scientific Report No. 1
George Tyras, Peter C. Bargeliotes, John M. Hamm, and Robert R. Schell Dec. 1964 41 p refs
(Contract AF 19(628)-3834)
(AFCRL-65-53; AD-612683)

A plasma simulation technique was developed which can be used to study the effects of homogeneous or inhomogeneous plasma sheath on the radiation pattern deterioration and input impedance of microwave antennas. A tank was designed and constructed for use in the simulation technique which can reproduce by means of real dielectric materials the dielectric constant encountered in plasma covered antenna research. The radiation patterns and the input impedances of an annular slot and a thin and long rectangular slot were successfully measured in the presence of a simulated lossless, homogeneous and isotropic plasma layer of varied thickness. Comparison with the available theoretical data indicates a generally good agreement, although some differences exist. In the case of the radiation patterns these differences are attributed to the finite distance between the radiator and the receiving antenna on one hand and the inherent inaccuracy of the saddle point method of integration in certain regions on the other hand. Author

N65-22397# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrophysics
WAVES GUIDED BY A BOUNDARY WITH TIME-SPACE PERIODIC MODULATION
E. S. Cassedy 22 Jan. 1965 52 p refs
(Contracts AF 19(604)-7499; AF 19(628)-4324)
(PIBMRI-1251-65; AFCRL-65-116; AD-612965)

Electromagnetic waves guided by a plane surface impedance which is modulated periodically in time and space in the traveling-wave sense are considered. A linearized statement of the nonlinear parametric interaction of waves on an open waveguide structure is investigated. In linear treatment the rigorous approach is taken formerly used on (purely spatial) periodic structures. Parametric wave interactions of both the stable and the (potentially) unstable type are examined. The regions of operation for bound surface waves, as opposed to (radiating) leaky waves are determined for this structure. A region of operation called the sonic region is found which represents a form of an electromagnetic shock wave. This sonic region precludes the possibility of traveling-wave amplification along the length of the structure. The results are forthcoming only from the complete treatment, including the effects of all time-space harmonics. The power mixing principle for all harmonic waves is determined to be the Manley–Rowe power–frequency relation applied at the boundary surface. Author

N65-22399# Innsbruck Univ. (Austria).
ON THE PROPAGATION OF VLF WAVES IN SOLIDS Technical Annual Summary Report No. 4
W. Bitterlich Dec. 1964 105 p refs
(Contract AF 61(052)-490)
(AFCRL-65-203; AD-613593)

In the report, different measuring devices, transmitting and receiving antennas (direction-finder antennas) for the vlf region are discussed. The measurements of propagation in inhomogeneous rock are mainly concentrated to the determination of the direction of the field vector at the point of reception. The problem near field–far field of a vlf dipole is also discussed. In order to determine the electrical parameters of rock, comprehensive measurements were conducted in solid rock and in rock samples. Furthermore the frequency dependence of σ and ϵ was studied. The influence of the gallery configuration on the result of a σ-measurement was studied in detail. The theoretical part mainly deals with the problems of excitation of a vlf wave in rock, giving a detailed comparison between electrical and magnetic dipoles. TAB

N65-22419# Stanford Research Inst., Menlo Park, Calif.
RADIATION AND RECEPTION OF ELECTROMAGNETIC ENERGY FROM AIRCRAFT AND GUIDED MISSILES Final Report, Feb. 1962–Sep. 1964
J. E. Nanevicz Oct. 1964 25 p refs
(Contract AF 19(628)-325)
(AFCRL-64-891; AD-613011)

The report gives descriptions of the various investigations undertaken on the research program conducted on missile and aircraft antennas from February 1962 through September 1964. These investigations are grouped under three general categories: the effects of antenna environment upon its performance, experimental studies, and studies related to antenna systems. The relationship of this work to other work at Stanford Research Institute and to the aircraft and missile antenna development program of the Air Force is briefly discussed. The report includes a list of the technical reports published on the contract. Author

N65-22448# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISTRIBUTION OF ELECTROMAGNETIC FIELD AND CURRENT IN THE GROUND IN THE CASE OF A VERTICAL ANTENNA

I. Constantinescu 30 Mar. 1965 15 p refs Transl. into ENGLISH from Telecomunicatii (Bucharest), v. 7, no. 2, 1963 p 45–50 (FTD-TT-65-78/1+2+3+4; AD-613458)

A method of rectangular coordinates in the case of radial fields is used to determine the distribution of electromagnetic field and current in the ground in the case of a vertical antenna. TAB

N65-22452# Mithras, Inc., Cambridge, Mass.
RESEARCH OF AERODYNAMIC METHODS OF PRODUCING ANTENNA WINDOWS IN A PLASMA SHEATH Scientific Report No. 1, 14 Oct. 1963–14 Oct. 1964
Richard H. Adams and Joseph J. Rossi Oct. 1964 100 p refs
(Contract AF 19(628)-3852)
(MC-63-78-R1; AFCRL-65-65; AD-614084)

Two aerodynamic methods of creating transmission windows in typical plasma sheaths surrounding reentry vehicles were investigated: the use of jets of coolant from flush nozzles which penetrate across the plasma slab and then mix with the ionized gases as they are carried downstream; and the use of a physical flow diverter to bypass some of the ionized flow laterally around the antenna. Equations are developed for the lateral jet penetration in a supersonic stream and for one-dimensional mixing for both perfect gases and real gases in thermodynamic equilibrium. The assumption of real-air equilibrium thermodynamics yields coolant requirements considerably below the perfect gas values for the jet injection method. It is concluded that the jet injection method will reduce a 200 Mc signal attenuation to 3 dB with modest jet flow rates of helium on a typical reentry trajectory. Conversely, the use of a physical flow diverter is not an effective method of creating a transmission window where the ionization layer is not adjacent to the vehicle surface or where the attenuation needs to be reduced more than 10 dB. Author

N65-22454# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory
A THEORETICAL INVESTIGATION OF VAN ATTA ARRAYS Scientific Report No. 1
Tove Larsen Nov. 1964 37 p refs
(Contract AF 61(052)-794)
(S127-R39; AFCRL-65-162; AD-613614)

A scheme has been set up for an analytical investigation of an arbitrary Van Atta reflector. Each pair of antenna elements is represented by an equivalent circuit using equivalent X-circuits for the transmission lines. Reradiation from the elements and mutual impedances have been taken into account. The theory is illustrated with some numerical examples of a linear reflector consisting of four half-wave dipoles. Author

N65-22456# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory
LINEAR VAN ATTA REFLECTOR CONSISTING OF FOUR HALF-WAVE DIPOLES Scientific Report No. 2
J. Appel-Hansen Nov. 1964 27 p refs
(Contract AF 61(052)-794)
(S127-R40; AFCRL-65-205; AD-613607)

A theoretical and numerical investigation of a linear Van Atta reflector consisting of 4 parallel halfwave dipoles with the same distance between adjacent elements has been made. An expression for the reflected field has been found by considering each dipole as a receiving and transmitting antenna matched to its transmission line. Mutual impedances are taken into account. In order to study the general form of the reradiation pattern analytically the mutual impedances were at first neglected. The analysis reveals, among other things, that the direction of maximum reflection often is not back in the direction of arrival of the incident field, and that for some lengths of the transmission lines and directions of arrival, the reflected field is zero. Numerical calculations have been made with a half wavelength spacing between the elements. It turns out that the induction usually introduces asymmetry into the reradiation pattern. This means that it is possible to increase the radiation back in the direction of arrival by properly choosing the distance between the dipoles and the length of the transmission lines. When the spacing between the dipoles is a half wavelength the most suitable length has been found. Author

N65-22467# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
METHODS FOR PSYCHOACOUSTIC EVALUATION OF SPEECH COMMUNICATION SYSTEMS Final Report
Carl E. Williams, Michael H. L. Hecker, and Karl D. Kryter Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 54 p refs
(Contract AF 19(628)-382)
(BBN-1212; ESD-TDR-65-153; AD-611767)

A review is presented of research conducted in the development and evaluation of a "modified rhyme test" for the measurement of the intelligibility of speech transmitted over communication systems. This new multiple choice intelligibility test is suitable for both laboratory and field use. Statistics concerning reliability and sensitivity of the test as a function of the number of listeners and the number of test repetitions are presented. The results of a series of experiments concerned with some of the variables involved in the development of a speaker identification test for the evaluation of speech communication systems are described in detail. Author

N65-22700# RAND Corp., Santa Monica, Calif.
MORE ON DETECTION OF FLUCTUATING TARGETS
P. Swerling Feb. 1965 11 p refs
(P-3037; AD-611266)

It is the purpose of this note to derive the characteristic function of the video integrator output (assuming pulsed waveforms) for completely arbitrary probability distribution functions of the signal fluctuations, and for completely arbitrary correlation properties; that is to say, for a completely arbitrary joint probability distribution of the individual pulse signal-to-noise ratios, (subject, however, to the assumption that the signal amplitude and phase do not fluctuate within a single pulse). The forms taken by this result will be exhibited in some special cases. A brief discussion will be given of computational schemes based on the characteristic functions thus obtained. TAB

N65-22757 White Sands Missile Range, N. Mex.
ACCURACY AND INFORMATION RATE STUDIES ON TARGET CROSS SECTIONS UTILIZING THE NIKE HERCULES RADARS
Gabriel E. Galos *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 349–361 (See N65-22732 12-34)

Studies indicate that log pulse height information at the repetition rate of the radar must be used to determine the detailed statistical characteristics of missile targets. On the other hand long-term (order of 1 second) average characteristics can be determined by use of Apollo guidance computer (AGC) data alone. For slowly fluctuating targets, the AGC data are quite adequate. The overall accuracy of the determination of radar cross section is dependent on range and S/N. Author

N65-22784 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
TRANSMITTER AND ANTENNA FEED FOR BLACK BRANT III ROCKET TELEMETRY
J. H. Craven and J. K. Pulfer *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 8–14 refs From Bull. of Radio and Elec. Eng. Div., v. 11, no. 4, Dec. 1961 (See N65-22781 12-31)

The radiofrequency portion of the transmitter consists of an oscillator at 56.4 Mc/s driving a quadrupler with an output of one watt at 225.7 Mc/s. The oscillator operates in the tuned-plate tuned-grid configuration with modifications for high-power high-frequency operation and for crystal control while allowing frequency modulation. An amplifier and a series regulator complete the transmitter. The quadraloop antenna system designed for Mach 7 operation consists of two shunt-fed quarter-wave radiators mounted on opposite sides of the rocket. A power splitter matches the two cables to the feed from the transmitter, and a feed-through capacitor provides a dc bias to overcome voltage breakdown of the antennas at high altitudes. For the first two flight tests, a vacuum tube transmitter and blade antenna system will also be provided. A cross monitor will check the operation of both systems and, in the event of failure of one system, telemeter information about the failure on the other telemetry system. The detector outputs from the cross monitor were found also to be so valuable in tuning the transmitters that they will be incorporated for preflight checkout in later Black Brant III flights. M.P.G.

N65-22785 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
TELEMETRY ANTENNA SYSTEM FOR BLACK BRANT III ROCKETS
F. V. Cairns *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 15–20 refs From Bull. of Radio and Elec. Eng. Div., v. 12, no. 2, Jul. 1962 (See N65-22781 12-31)

The main design requirements that led to the selection of a quadraloop antenna system for the Black Brant III sounding rocket are listed, and the actual system is described. It consists of two shunt-fed radiators mounted on diametrically opposite points of the rocket skin and fed out of phase through a matched power divider. A relative phase shift of 180° is obtained by connecting the radiators to the power divider with cables differing in length by a half-wavelength. The radiofrequency characteristics of the materials used were tested to temperatures over 1400° F. A negative bias of 30V was applied to the antennas to increase their power-handling capacity. No significant defects in the performance of this antenna system were revealed in the first four test firings. Expansion due to heating seems to have caused an impedance change which is undesirable but not serious. Telemetry and signal strength records indicate that voltage breakdown did not occur. M.P.G.

N65-22786 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
A TELEMETRY GROUND RECEIVING STATION
L. G. Cox *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 21–26 From Bull. of Radio and Elec. Eng. Div., v. 12, no. 2, Jul. 1962 (See N65-22781 12-31)

The telemetry ground station described was designed as a trailer-mounted installation for use as a receiving and recording station, as a telemetry checkout station, and for postflight data extraction. A block diagram of the station components and circuits is presented and discussed. The composite video signal from the basic rocket telemetry package, (consisting of 10 subcarriers, 9 modulated by continuous inputs and 1 by 25 commutated inputs) is recorded on one track of the magnetic tape during flight, and range timing is recorded on 1 or 2 tracks. After the flight, the magnetic tape reproducer is used as the signal source for extraction of the modulating waveforms of the subcarrier oscillators. An audio amplifier with a loud speaker is used to identify zero time on the tape. Suitable combinations of discriminator and/or decommutator outputs are recorded simultaneously on the direct printing multiple-channel oscillograph recorder at the minimum paper speed necessary for resolution of the highest recorded frequency. Other equipment used primarily for calibration or checkout includes a 200-cps to 100-kc/s oscillator, an FM/AM signal generator, an ac voltmeter, a frequency counter, a dual-trace oscilloscope, and video and coaxial patch panels. M.P.G.

N65-22811# Lincoln Lab., Mass. Inst. of Tech., Lexington
SMOOTHING AND PROCESSING SIMULATED AMRAD TRAJECTORY DATA
A. Bertolini and S. F. Catalano 21 Jan. 1965 36 p refs *Its* Group Rept. 1965-7
(AD-612151)

In this report, an attempt is made to determine suitable smoothing intervals to be used in the smoothing of radar trajectory data. This is done by using different fitting intervals in the smoothing of simulated noisy trajectory data of different signal-to-noise ratios. The errors, or differences between the true noiseless data and the smoothed noisy data, were observed and plotted. Minimum errors were obtained when the range smoothing interval was approximately 1 to 2 seconds and the elevation and azimuth smoothing intervals 10 seconds. The plots suggest that elevation and azimuth errors can be further reduced by smoothing over intervals longer than 10 seconds but this would not be practical in many actual missile shots. Author

N65-22817# Hughes Aircraft Co., Culver City, Calif. Aerospace Group
MOSAIC RADAR STUDY PROGRAM Quarterly Progress Report, 1 Aug.–31 Oct. 1964
W. H. Kummer and L. L. Bailin 15 Nov. 1964 51 p refs
(Contract NOw-64-0350-d)
(P64-124; AD-458471)

An analysis of nonrandom errors that affect the angular tracking accuracy of the Mosaic radar is presented. The effects of these errors are considered for two cases: (1) with coherent signal detection used in each channel, and (2) with envelope signal detection used after summing in two adjacent channels. Nonrandom error computations are obtained for both cases and several examples are computed to illustrate the effect of errors in the various system parameters on the overall angular error. The computation includes the experimental results that were obtained to determine the actual errors in the lens system. S.C.W.

N65-22875# Joint Publications Research Service, Washington, D. C.
OPTIMUM WORKING FREQUENCIES IN SHORT-WAVE COMMUNICATIONS
V. A. Baranul'ko 19 Apr. 1965 19 p refs Transl. into ENGLISH of Chapter 1 of the book "Osobennosti Rasprostraneniya Radiovoln", Moscow, 1964 p 19–36
(JPRS-29660; TT-65-30771) CFSTI: $1.00

CONTENTS:
1. OBLIQUE-RETURN SOUNDING p 1–12 refs (See N65-22876 12-07)
2. LIMITING FREQUENCIES WITH RESPECT TO ABSORPTION p 12–16 refs (See N65-22877 12-07)

N65-22876# Joint Publications Research Service, Washington, D. C.
OBLIQUE-RETURN SOUNDING
In its Optimum Working Freq. in Short-Wave Commun. 19 Apr. 1965 p 1–12 refs (See N65-22875 12-07) CFSTI: $1.00

Described is the method of oblique-return sounding from the ionosphere to determine the optimum working frequencies and zones of reliable radio receptions between two points located at a distance of 4000 km or more from each other. This ionospheric radar operates on the principle of scattering of radio waves from the ground after reflection from the ionosphere. Part of the scattered energy is returned to the source of radiation, and the delay time of the reflected signal is recorded. The amplitude of the scattered reflection depends upon the distance to the source of scattering, upon absorption in the ionosphere, and upon the radiation patterns of the transmitting and receiving antennas. Several examples of obtained return signals are presented, and a definite frequency dependence of the upper limit of working frequencies upon the distance was established. It was concluded that the working frequencies should not approach the boundary of the illuminated zone because it induces fading. Oblique-return sounding at 4000 to 10000 km and more is only possible with the use of multiple reflections from the ionosphere. G.G.

N65-22897# Meridian Metalcraft, Inc., Whittier, Calif.
WEATHERIZED GLIDE SLOPE ANTENNA AND ARRAY DISTRIBUTION NETWORK Final Report
L. M. Struve Mar. 1965 144 p
(Contract FA-WA-4511)
(RD-65-22)

Objectives were to develop an improved performance weatherized glide slope antenna with built-in monitoring provisions and an array distribution network for use with the improved antennas, and to produce an increased amount of azimuth directivity to the radiation pattern. Study and test program of required parameters for the antenna and distribution network indicated that an antenna (using a semi-elliptic radome with provision for heating the antenna element ground plane would produce the optimum design in meeting all-weather performance requirements. From array mathematical analysis optimum design for a distribution network feeding a three element array was determined to be one in which the antennas were spaced $3/4\lambda$ fed in phase with a voltage excitation of 1.0, 1.0 and 0.5. Prototype models of the antenna array distribution network, with associated connecting cables and mounting frame were designed and manufactured. Design assurance testing was performed on the weatherized glide slope antenna and antenna array distribution network; both items met all requirements. Author

N65-22954# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EL CAMPO SOLAR RADAR ANTENNA MODIFICATION
M. E. Devane 8 Feb. 1965 23 p ref *Its* Group Rept.-1965-12
(Contract AF 19(628)-500)
(ESD-TDR-65-44; AD-612150)

The east–west aperture of the solar radar antenna was doubled. Mechanical and electrical improvements incorporated at the time of the expansion, together with the increased size, resulted in an increase in gain of approximately 3-1/4 dB. Author

N65-22966# Milan Univ., Italy. Inst. of Physics
SIGNAL TRANSMISSION FOR SPACE CONVEYANCES USING THE NUMERICAL TELEMETRY SYSTEM [LA TRASMISSIONE DI SEGNALI CON SISTEMI NUMERICI DI TELEMISURA PER VEICOLI SPAZIALI]
Umberto Pellegrini Milan, Lab. Elettronici e Nucl. [1964] 34 p refs In ITALIAN Presented at the Space Congr., Rome, Jul. 1963 Submitted for Publication

A study of time-division multiplex telemetry and data reduction systems with particular application to space vehicles has been conducted. Typical frequency spectrums of recovered signals are analyzed for errors caused by sampling rates, quantitization, and interpolation. Trans. by P.F.E.

N65-22972*# Northrop Space Labs., Huntsville, Ala.
APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES. GROUND WAVE PROPAGATION ON THE LUNAR SURFACE FOR A LUNAR MOBILE LABORATORY
J. D. Hughlett, Jr. Jun. 1964 44 p refs
(Contract NAS8-11096)
(NASA-CR-61045) CFSTI: HC $2.00/MF $0.50

The results of a ground wave propagation study for an over-the-lunar-horizon communication system are presented. It was found that a frequency in the medium range vertically polarized offered the best application to over-the-horizon type lunar surface communication system. This polarization was chosen because the moon could have a short-circuiting effect on the electrical intensity of the horizontal polarized wave which would offer resistance to this component of the vertical wave. The characteristics of the moon as a conductor can be described in terms of conductivity and dielectric constants. Although no experimental data are available on lunar soil characteristics, the values of conductivity and dielectric constants selected were 10^{-3} to 10^{-4} mhos/meter, and 2.0, respectively. The rf power requirements, antenna efficiency, optimum frequency, and system weight are reported. E.E.B.

N65-22980# Federal Aviation Agency, Washington, D. C.
COMPARISON OF TWO VHF COMMUNICATION FREQUENCY ASSIGNMENT METHODS
John B. Pyle and Paul T. Astholz Mar. 1965 29 p refs
(RD-65-21)

Comparison of present geographical multichart and proposed matrix methods was conducted using a sample problem area. In manual operation, the proposed method offered no major advantages over the present method. However, the matrix method is promising when used in conjunction with a digital computer if the use of a computer can be justified from a cost–benefit viewpoint. Author

N65-22982# Industrial Science and Technology Agency, Tokyo (Japan).
STUDIES ON THE STANDARD REACTANCE ATTENUATOR
Takeo Abe Aug. 1964 104 p refs In JAPANESE; ENGLISH summary *Its* Res. of the Electrotech. Lab. No. 652

Studies are presented on the cylindrical standard reactance attenuator (waveguide below-cutoff piston attenuator) in order to establish and improve the high frequency signal voltage standard. Included are papers on (1) the improvement of the nonlinear decibel range of the reactance attenuator in the region of relatively close coupling between exciting and receiving antennas; (2) the effect of using mode suppressor to resolve nonlinear to decibel characteristics in the region of relatively close coupling between exciting and receiving antennas; (3) the effect of finite conductivity on the attenuation constant of the reactance attenuator; (4) the effect of variation of contact between outer and inner guide of the reactance attenuator to the attenuation constant; and (5) the improvement of the higher mode type attenuator (H_{01} mode and E_{01} mode). Related theories are presented in conjunction with these studies. S.C.W.

N65-23005# Harry Diamond Labs., Washington, D. C.
SOLDER-GLASS SEALING OF MICROWAVE ANTENNA WINDOWS
T. V. Blomquist 13 Nov. 1964 10 p
(TM-64-28; AD-610837)

Simple solder-glass techniques are described for vacuum-tight sealing of mica and glass microwave windows in a metal frame having a compatible coefficient of thermal expansion. The seal is made by applying 0.020-in. diameter threads of solder glass to heated frame and window. A hand torch and quartz boat proved satisfactory for heating with mica of thicknesses of 0.003 in. or greater. A simple cone resistance heater with variac, and a metal table provided more precise heating for sealing thinner windows. The materials are inexpensive; the procedure and equipment are simple. Author

N65-23048# Naval Research Lab., Washington, D. C. Radar Div.
THE CALCULATION OF FREQUENCY-MODULATION DISTORTION IN LINEAR NETWORKS
O. D. Sledge 6 Jan. 1965 9 p refs
(NRL-6183; AD-612097) CFSTI: $0.50

A numerical method for calculating the steady-state fm distortion in a linear passive network using a sideband-type of analysis is developed to achieve economy of digital computer time and, for a given network, to find the number of significant sideband pairs associated with a given maximum allowable level of fm distortion. To illustrate the application of the method, the fm distortion introduced by a band-pass filter is calculated over a range of signal parameters. A useful by-product of the fm distortion calculations is a formula for the minimum ratio of the bandwidth of the filter to twice the frequency deviation of the input signal necessary to assure that the fm distortion introduced by a band-pass filter is less than 5%. Author

N65-23067*# General Electric Co., Huntsville, Ala. Command Systems Div.
IR TELEVISION SYSTEM FOR FAULT DETECTION. ALTERNATE I—CONTRACT SYSTEM
E. G. Butts 3 Mar. 1965 10 p
(Contract NAS8-11715)
(NASA-CR-62578) CFSTI: HC $1.00/MF $0.50

An infrared television camera which uses an infrared vidicon tube to image radiation well into the electromagnetic spectrum is described. The camera system includes two basic units, the camera head assembly and the control set. The camera head contains the infrared vidicon tube and the related electrical components which produce the video signal or electrical readout of the scene imaged on the vidicon target by the lens. The control unit provides electrical excitation for the elements in the camera head. It also provides amplification for the video signal compatible with standard monitors. Liquid-nitrogen cryogenic cooling required by the infrared vidicon tube is supplied by an open dewar mounted on the camera head. Detail description of the head assembly, control set, signal processor, TV monitor, mechanical mounting, and electrical connections are given. Further, the specifications for the system are included. E.E.B.

N65-23084# Radiation, Inc., Melbourne, Fla.
REDUNDANCY-REDUCTION DEVICE Final Report, Jul. 1962–Apr. 1964
5 May 1964 42 p
(Contract AF 33(657)-9210)
(AL-TDR-64-10; AD-600786)

A study was conducted to establish and evaluate techniques for the reduction of redundancy in pulse code modulated (PCM) telemetry data. An experimental equipment was designed and fabricated to demonstrate one of the techniques. The equipment provides for processing up to four multiplexed segments of either real or simulated data (in a prescribed format) to determine the effect of redundancy reduction on the reconstructed data. Two general types of redundancy reduction techniques were examined. The first depends upon detecting periods during which the magnitude of the data samples changes less than some assigned tolerance. This technique requires a step interpolation in the reconstruction of the data. The second type detects the periods during which the data are changing by a nearly constant amount between adjacent samples. These techniques permit linear interpolation between nonredundant samples. The various techniques were compared for their relative effectiveness in achieving a reduction in transmitted bit rate. It is concluded that the appropriateness of applying a particular technique depends upon the nature of the data, the initial sampling rate, and the use to which the data is to be put. Author

N65-23132# Gt. Brit. Dept. of Scientific and Industrial Research. Radio and Space Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY PREDICTION SERVICE FROM EDINBURGH, FEBRUARY 1964
1965 48 p */ts* Issue 8

Cinetheodolite film measurements of elevation and azimuth for a number of satellites were made during February 1964. The observations were made in rapid sequence over a period of 2 to 3 minutes. The number of usable film frames varied considerably from satellite to satellite, with the lowest number being 16 and the highest 170. Weather conditions and a quantitative score for satellite visibility are listed with the data. The satellites observed were Transit IB, Midas IV, Alouette rocket, Starfish, Anna IB rocket, Midas VII, Midas VII fragment, Poljet I, Echo II rocket, and an unidentified satellite. The films were taken at the COSPAR station in Earlyburn, Eddleston, Peebles, Scotland. Collimation and other corrections were applied to the measurements. J.M.D.

N65-23161*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SURVEY OF CONTINUOUS-LOOP MAGNETIC TAPE RECORDERS DEVELOPED FOR METEOROLOGICAL SATELLITES
Kenneth W. Stark and Arthur F. White, Jr. Washington, NASA, (NASA-TN-D-2766) CFSTI: HC $1.00/MF $0.50

Meteorological satellites collect infrared data and video pictures of the earth's cloud cover and store them on board for transmission while in the vicinity of a ground station. Most economical and efficient method of data storage is the use of an onboard magnetic tape recorder and continuous-loop magnetic tape cartridges. Advantages of this combination are that the most recent data are always transmitted to the ground stations and multiple interrogations are possible. A satellite tape recorder is subjected to a severe environment which its mechanical design must withstand. It also must have a sophisticated electrical design to serve the data storage requirements of a meteorological satellite. This paper describes the recorder design concepts and products evolved, and their utilization in meteorological satellites. Author

N65-23174*# Stanford Research Inst., Menlo Park, Calif.
PCM TELEMETRY: A NEW APPROACH USING ALL-MAGNETIC TECHNIQUES

C. H. Heckler, Jr. and J. A. Baer Washington, NASA, May 1965 97 p refs
(Contract NAS1-3380)
(NASA-CR-229) CFSTI: HC $4.00/MF $0.75

The feasibility of an all-magnetic PCM telemetry system was studied, and the logic design of a 12-channel PCM telemetry system was made. The design requires some 700 magnetic cores and 50 transistors. The system is completely digital, departing from the conventional design, which requires the amplification of analog signals. During this study, several novel magnetic circuits were found. An investigation of the reliability of magnetic cores was also made. It was found that three large producers of magnetic cores have no record of in-service failures for this class of element. Author

N65-23202# Magnavox Research Labs., Torrance, Calif.
STUDY OF CORRELATION PROPERTIES OF BINARY SEQUENCES Interim Report No. 1, 15 Oct. 1963–15 Jan. 1964
Robert Gold 13 Jan. 1964 43 p
(Contract AF 33(615)-1011)
(R-692; AD-431113)

Correlation properties of linear binary sequences were studied; if mutually independent (and therefore uncorrelated) binary sequences could be constructed they would be useful as signals for communications applications. Linear binary sequences are good signal candidates since they are easily generated by single shift registers. A method based on a shift register polynomial is demonstrated for determination of classes of sequences with bounded cross correlation, and for calculating bounds on the cross-correlation function of certain maximal sequences and hence on the corresponding family of sequences. Theorems on elementary properties and the algebraic nature of sequences are presented with proofs. An appendix is included on error correcting codes. J.M.D.

N65-23225*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
OPTIMUM QUANTIZATION Technical Report 429
James D. Bruce 1 Mar. 1965 76 p refs
(Grants NsG-496; NSF GP-2495; NIH MH-04737-04; Contract DA-36-039-AMC-03200(E))
(NASA-CR-62742)

The exact expression for the quantization error as a function of the parameters defining the quantizer, the error-weighting function, and the amplitude probability density of the quantizer-input signal is presented. An algorithm is developed that permits the determination of the specific values of the quantizer parameters that define the optimum quantizer. This algorithm is then extended so that optimum quantizers can be determined for the case in which the quantizer-input signal is a message signal contaminated by noise. In each of these cases the algorithm is based on a modified form of dynamic programing and is valid for both convex and nonconvex error-weighting functions. Examples of optimum quantizers designed with the first of these two algorithms for a representative speech samples are presented. The performance of these optimum quantizers is compared with that of the uniform quantizers. Author

N65-23227# Gt. Brit. Dept. of Scientific and Industrial Research. Radio and Space Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY PREDICTION SERVICE FROM EDINBURGH, JANUARY 1964
[1965] 19 p *Its* Issue 7

Elevation and azimuth observations on various orbiting satellites were drawn from kinetheodolite film taken at the COSPAR station in Peebles, Scotland, during January 1964; collimation and other corrections were applied to the readings. The observations were made during an interval of about 3 minutes, and the number of good frames varied between 20 and 180. Along with the observation date and the times for the individual readings, indication of weather condition and satellite visibility is given. These satellites are the Transit IVA, Midas IV, Midas VII, Midas VII fragment, Alouette rocket, Poljet I, and Echo II rocket. J.M.D.

N65-23265# Gt. Brit. Dept. of Scientific and Industrial Research. Radio and Space Research Station
KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY PREDICTION SERVICE FROM EDINBURGH, MARCH 1964
1965 28 p *Its* Issue 9

Corrected observations of satellite elevation and azimuth are listed. The positions of nine rockets and manmade satellites were recorded on cinetheodolite film at the COSPAR station in Scotland in March of 1964. A series of films were taken for 3 to 7 minutes; the highest number of good films on a satellite was 130, and 4 was the lowest. A statement is made about observing conditions, and the visual magnitude of the satellite was estimated. The satellites tracked were Midas IV, Cosmos XI, Explorer XVI, Geophysics Research Satellite, Explorer XIX, Cosmos XXV rocket, and three nameless satellites. J.M.D.

N65-23278*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPTIMAL COMMUNICATION NETS
R. J. Mc Eliece 15 Apr. 1965 12 p refs
(Contract NAS7-100)
(NASA-CR-62612; JPL-TR-32-697) CFSTI: HC $1.00/MF $0.50

The following problem is posed: If $\overline{\lambda}$ is the average separation between vortexes in a finite, connected, undirected graph and m is the total number of edges, which graph with n vortexes minimizes $m\overline{\lambda}$? The unique solution is shown to be the star graph. Variance of this is done with weighted paths and probabilistic weights. Author

N65-23279*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RANGER 5 TRACKING SYSTEMS DATA ANALYSIS Final Report
C. E. Mc Neal 15 Apr. 1965 138 p
(Contract NAS7-100)
(NASA-CR-62608; JPL-TR-32-702) CFSTI: HC $4.00/MF $1.00

Results are reported of the analysis of the tracking performance carried out for Ranger 5. Preflight preparations and the results of postflight analysis are discussed. Tracking performance of the stations was determined by a study of tracking data, oscillographs and station reports, and preflight and postflight calibrations. Author

N65-23280*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATION OF THE STATISTICAL THEORY OF EXTREME VALUES TO SPACECRAFT RECEIVERS
John C. Ashlock and Edward C. Posner 15 May 1965 13 p, ref
(Contract NAS7-100)
(NASA-CR-62638; JPL-TR-32-737) CFSTI: HC $1.00/MF $0.50

This report considers the problem of error probability estimation in systems involving a threshold detector. The estimation procedure which merely observes the occurrence of errors is too slow, whereas the procedure which attempts to find a theoretical distribution for amplitude deviations and then predicts error probabilities from the tails of this distribution is too unreliable. Extreme-value theory, a procedure in use in fields such as flood control, monitors not only the occurrence of errors but also how close the detection scheme comes to making errors even when no error is made. Thus, the maximum amplitude deviation in a large number of bits is recorded as a new datum. The distribution of these extreme data then has an extreme-value distribution. The parameters of the extreme-value distribution are estimated, and this in turn yields an estimate of the error probability. There is a saving of a factor of 10 in test time over mere bit error testing. The distributions obtained from actual threshold systems are shown to fit the theoretical distribution very well. The method was used to test the command receivers in Rangers VII, VIII, and IX. Author

N65-23282*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-32, VOLUME III FOR THE PERIOD JANUARY 1, 1965 TO FEBRUARY 2, 1965. DEEP SPACE NETWORK
W. H. Pickering 31 Mar. 1965 84 p
(Contract NAS7-100)
(NASA-CR-62609; JPL-SPS-37-32, Vol. III) CFSTI: HC $3.00/MF $0.75

A precision communication system designed to communicate with, and permit control of, spacecraft designed for deep space exploration is discussed. Major subjects covered are tracking stations engineering and operations, communications engineering developments, communications research and development, and advanced antenna system. Further, the mission, organization, and capabilities of the network are also discussed. E.E.B.

N65-23328*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering
DIGITAL TECHNIQUES AND LONG-RANGE COMMUNICATION STUDY PROGRAM Final Report
S. W. Golomb [1965] 11 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950729)
(NASA-CR-62633; USCEE-116) CFSTI: HC $1.00/MF $0.50

Coding to protect synchronization was studied from several points of view, and recent work involved the hybridization of synchronization coding with error-correcting codes. The influence of data processing on optimum communications was also considered. Barker sequences were generalized to nonbinary alphabets, and the transformations which leave the Barker property invariant were identified. This work has direct applications to coded range radar. In addition to investigating nonbinary ranging codes, "polyphase coding" for a Gaussian telemetry channel was also studied. A number of special problems relating to algebraic coding were investigated, and codes, decoders, and other special-purpose computer devices were examined from the viewpoint of mathematical machine theory. A statistical analysis of English text as a Markov source has been undertaken. Digram and trigram statistics were computed on the basis of one-third of one million letters of newspaper text, and the corresponding digram and trigram entropies were computed. Author

N65-23330*# Technical Research Group, Inc., East Boston, Mass.
[DESIGN OF TWO FREE SPACE ROOMS FOR THE MEASUREMENTS OF HIGH PERFORMANCE AND GENERALLY LOW GAIN ANTENNAS] Final Report
29 Jan. 1965 43 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951100)
(NASA-CR-62623; TRG-245) CFSTI: HC $2.00/MF $0.50

Longitudinal baffles, transverse irises, pyramidal back walls, and tilted back walls were incorporated in the design of free space rooms to determine if these features would improve the electrical performance of these rooms and if so to determine their proper design. The study is specifically aimed at the design of two free space rooms to be used for measuring high performance and generally low gain antennas. A given box shaped room is assumed whose six walls are completely covered with a high quality absorber. Also assumed is a fixed transmitting antenna of good design on or close to the front wall, and a receiving or test antenna which may be rotated in any position at a point near the back wall. Results show that room stereometry can give a theoretical improvement in reflection beyond that of the absorber covered flat wall. A dentated absorber is desirable because it has both greater absorption and produces partially the effect of stereometry. Irises, fences and baffles with slope discontinuities are not recommended. A mount was found to be superior to a tilted back wall since it did the required job without taking up as much room space. Design dimensions of the recommended mound and a transmitting antenna are presented.
S.C.W.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-22295 Army Personnel Research Office, Washington, D. C.
INFORMATION ASSIMILATION FROM COMMAND SYSTEMS DISPLAYS
Semour Ringel *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 261-274 (See N65-22275 12-34)

The scope, rationale, and organization of the research program on automated systems for receipt, processing, storage, retrieval, and display of different types and vast amounts of military data are discussed. Also, the critical information processing functions in a tactical operations center are reviewed. Information assimilation from alpha-numeric displays; information coding for conspicuity in such displays; information assimilation from symbolic displays; certitude and information assimilation from these displays; and coding, hard copy, type, and extent of updating of symbolic information are covered. For each of these sections, the purpose, method, results, and implications are given. E.E.B.

N65-22380# Radio Corp. of America, Van Nuys, Calif. Aerospace Systems Div.
COMPUTER ALGORITHM FOR FAULT ISOLATION AND TEST POINT SELECTION Technical Report, 15 Feb.-5 Dec. 1964
S. M. Fisch and G. R. Brigida Wright-Patterson AFB, Ohio. Res. and Technol. Div., [1965] 191 p ref
(Contract AF 33(615)-1347)
(AFAPL-TR-65-12; AD-613960)

This report presents the methods and results of a study to develop a computer algorithm for automatically selecting test point locations in an electronic circuit, for generating test measurements, and for designing a corresponding test procedure. The algorithm is oriented towards analog circuits where piece-part fault isolations are made using sequential

tests which can be performed either manually or on tape-controlled automatic test equipment. The algorithm was tested by introducing faults into the test circuit and then tests were made in accordance with the computer generated test procedure. The correct faults were selected and no false indications were present. The output from the computer program includes a specification of necessary test point locations, and a sequential test procedure including measured nominal values and test limits under both good and faulty circuit conditions. Author

N65-22422# System Development Corp., Santa Monica, Calif.
SIMULATION OF A TIME-SHARING SYSTEM
Gerald H. Fine and Paul V. Mc Isaac 29 Dec. 1964 26 p refs
Presented at the Inst. of Management Sci. Meeting (TIMS), San Francisco, 3–5 Feb. 1965
(Contract ARPA SD-97)
(SP-1909; AD-611868)

The paper describes the use of simulation techniques in the analysis of time-share system operation. The purpose and goals of this research effort are briefly outlined and some comments on the advantages and disadvantages of direct simulation for this type of work are given. The existing simulator models are described in terms of inputs, general flow, and outputs; and the results of initial investigations with these models are given. Work currently in progress is discussed, and some related problems that may possibly be studied in the future by similar methods are noted. Author

N65-22468# Stanford Univ., Calif. Dept. of Computer Science
AUTOMATIC GRADING PROGRAMS
George E. Forsythe and Niklaus Wirth 12 Feb. 1965 19 p
Presented at the Natl. Meeting of the Assoc. for Computing Machinery, Philadelphia, 27 Aug. 1964
(Contract Nonr-225(37))
(CS17; AD-611434)

The ALGOL grader programs are presented for the computer evaluation of student ALGOL programs. One is for a beginner's program; it furnishes random data and checks answers. The other provides a searching test of the reliability and efficiency of a rootfinding procedure. Essential properties of a computer system are given so that grader programs can be used effectively. Author

N65-22512# New York Univ., N. Y. Research Div.
A SURVEY OF PROGRAMMING ASPECTS OF "COMPUTER-CONTROLLED" AUTOMATIC TEST EQUIPMENT VOLUME II
Victor Mayper, Jr. Jun. 1964 71 p
(Contract NObsr-89288; Proj. Sete)
(SETE-210/78; AD-460857)

Remarks on particular computer-controlled external-type test equipment and computer-controlled system self tests being used by missile and launch vehicle manufacturers are presented. Each manufacturer was visited and information obtained on the systems tested, requirements, personnel, coding aids, on-line general purpose programs, operational test programs, aids to checkout and checkout methods, scheduling, documentation, communication medium, reason for using computer, biggest programing problem, and words per man-year. Also discussed are additional problem-oriented test language developments and problem-oriented languages for tape control. M.P.G.

N65-22528# Argonne National Lab., Ill. Applied Mathematics Div.
PROGRAM CATALOG WITH PERMUTED DESCRIPTION INDEX FOR CDC CO-OP COMPUTERS
N. J. Purcell Mar. 1965 94 p
(Contract W-31-109-ENG-38)
(ANL-7016) CFSTI: $3.00

A catalog of program abstracts and a permuted description index for CDC CO-OP and Argonne programs is given. The permuted description index is designed to overcome the problem of retrieving an arbitrary class of programs. The source entry is divided into the subfields of title, machine, language, material available, system, date, description, and classification code and installation. The entire list of the index is sorted according to a given collating sequence. Words which are not sorted are listed separately. L.S.

N65-22609# Advisory Group for Aeronautical Research and Development, Paris (France).
WIND TUNNEL DATA PROCESSING
Robert E. Covey (JPL) Mar. 1964 157 p refs
(AGARDograph-85)

This paper is an introduction to the problem of defining and selecting an automated data processing system for a wind tunnel facility. The restraints imposed by speed and accuracy requirements, and the characteristics of various facilities and types of testing, are discussed. Typical systems and system elements are described. A tabulation listing the present data processing systems for many wind tunnel installations and a sample specification for a modern system are included. Author

N65-22674# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
ANALYSIS OF THE EFFECT OF VARIANCE ON LINEAR PROGRAMMING PROBLEMS
Louis B. Chester (M.S. Thesis) Aug. 1964 107 p refs
(GRE/SM/64-1; AD-611273)

Three linear programs (LP) were studied to determine the effect of variance on problem solutions. IBM 1620 and 7090 computers were used to solve the LP problems as their payoff coefficients were varied within specified limits by random number generators. Analysis was based on relative frequency that various activities were selected at various deviations levels and the implicit prices of non-selected activities. Analysis of the means and standard deviations of implicit prices provided methods for measuring and predicting the sensitivity of LP problems. Similarities in behavior or problems having different degrees of sensitivity indicate general applicability of the analyses. Author

N65-22797# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN EXPERIMENT IN USING THE ELECTRONIC COMPUTER "STRELA" FOR PROCESSING MEASUREMENTS OF METEORIC PHOTOGRAPHS
A. K. Sosnova 23 Jan. 1963 13 p ref Transl. into ENGLISH from Byul. Komis. Po Kometam i Meteoram Astron. Sov. Akad. Nauk SSSR, no. 4, 1959 p 35–41
(MCL-1201/1+2+4; AD-295795)

The processing of measurements of meteor photographs by a computer incorporating a three-address system of instructions and a parallel means of storing, transmitting, and converting numbers and instructions is discussed. The initial data were gained by tracking photos of the meteors and their comparison with reference stars and the flow pattern of the calculations was put on punch cards and programed for a binary system. The computer executed the instructions in the program

and accomplished the output in table form. A flow pattern for transferring numbers to the base 60 to those to the base 2 (60→2) is described. G.G.

N65-22836# New York Univ., N. Y. Lab. for Electroscience Research
PATTERN ANALYSIS OF PLANAR GEOMETRIC CONFIGURATIONS Final Report, Nov. 1, 1963–Dec. 31, 1964
Herbert Freeman [1964] 36 p refs
(Grant AF-AFOSR-24-64)
(AFOSR-65-0389; AD-612020)

The results are described of a research study in pattern analysis. Four investigations were directly concerned with the processing of encoded graphical data in a digital computer, and the fifth was concerned with a special form of majority logic, the so-called M-out-of-N decision logic. The report briefly summarizes these investigations and lists the publications (with abstracts) resulting from the research work. TAB

N65-22838# ITT Communications Systems, Inc., Falls Church, Va.
MERGE PROGRAM
30 Oct. 1964 42 p
(Contract AF 19(628)-3358)
(AD-455546)

A program is described which produces an overall event tape that is used as input to the basic simulation of the MMSF model. Ten block buffer areas are used for input and output, as opposed to the signal block buffer areas used by its predecessor. The program merges a satellite tape, a special events tape, and a message tape in which either two or three tapes are specified. The program running time of a satellite tape with 11 input blocks, and a message tape with 3569 blocks is 5 minutes. The general flow of the program and a detailed description of all inputs and outputs are described. Further, complete program description, operating environment and instructions, testing, and operation are included. E.E.B.

N65-22867# Harry Diamond Labs., Washington, D. C.
CIRCUIT REALIZATION OF A SQUARE ROOT SUM OF SQUARES COMPUTER
Ira R. Marcus, Joseph W. Miller, Jr., and Albert J. Buschman, Jr. 25 Jan. 1965 35 p refs
(HDL-TR-1271; AD-613165)

An electronic system was developed to compute the square root of the sum of the squares for three input variables. The basic technique was to use a conventional triaxial accelerometer and to process the three input signals, giving as an output one waveform. This report covers specifically the design and evaluation of circuitry that (1) accepts input signals from the accelerometers during impact, and (2) computes an instantaneous magnitude of the acceleration–time curve continuously. The circuitry was determined operable over a dynamic range of 4 mV to 4 V, with a frequency response of 4 to over 4000 cps. A computational accuracy of within 5 percent has also been proved between 50 mV and 4 V; an accuracy to within 10 percent has been proved from 4 to 50 mV. Author

N65-22925# System Development Corp., Santa Monica, Calif.
TIME-SHARED COMPUTER OPERATIONS WITH BOTH INTERARRIVAL AND SERVICE TIMES EXPONENTIAL
B. Krishnamoorthi and Roger C. Wood 30 Oct. 1964 51 p refs
(SP-1848/000/00; AD-611866)

The concept of time-shared computer operations is briefly described, and a model of a time-sharing system is proposed, based on the assumption that both interarrival and service times possess an exponential distribution. Although the process described by this model is non-Markovian, an imbedded Markov chain is analyzed by exploiting the fact that the instants of completion of a quantum of service are regeneration points. It is shown that user congestion possesses a limiting distribution, and the method of generating functions is used to derive this distribution. The concept of cycle time is discussed, and two measures of cycle time developed for a scheduling discipline employing a single queue. Finally, a number of numerical examples are presented to illustrate the effect of the system parameters upon user congestion, system response time, and computer efficiency. Author

N65-22950# Aeronutronic, Newport Beach, Calif.
ACQUISITION COORDINATE COMPUTATION FOR TRACKING AND SURVEILLANCE SENSORS, PROGRAM DOCUMENT
R. G. Schinnerer and D. R. Thompson Dec. 1964 156 p refs
(Contract AF 19(628)-3438)
(U-3011; ESD-TDR-65-160; AD-612091)

A computer program has been developed to calculate acquisition coordinates of earth satellites for three types of sensors: planar fan, horizontal fan, and tracker. The program is equipped to consider the special requirements of phased array trackers. Included in the document are the program description, formulation, operating instructions, flow diagrams, and test cases. Author

N65-22953# Aeronutronic, Newport Beach, Calif.
INITIAL ORBIT MODULE PROGRAM DOCUMENT
C. Purcell and A. F. Hall Bedford, Mass., AFSC, Electron Systems Div., Dec. 1964 244 p refs
(Contract AF 19(628)-3393)
(ESD-TDR-65-78; AD-611140)

A computer program which determines initial orbit elements from various types of observations is described. Manual control over each stage of the computations may be exercised through program options. Completely automatic processing of observations to final orbit elements may also be obtained. The document includes mathematical formulations, operating instructions, test cases, program flow diagrams and listing. Author

N65-22988# European Atomic Energy Community, Brussels (Belgium).
INTERNAL STRUCTURE OF THE APACHE SYSTEM AND THE PROCEDURE TO USE IT ON THE DIGITAL COMPUTER
J. Annino, A. Debroux, G. P. Del Bigio, H. D'Hoop, C. Green et al 1965 23 p refs
(EUR-2278.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The APACHE code has been developed to carry out automatically on the digital computer the preliminary operations necessary for the study of a problem on an analog computer. The code was first presented at the 3rd International Conference on Analog Computing, Opatija, September 1961. This paper describes the main changes which have occurred during the implementation of the system as well as the internal structures of the system itself. Author

N65-22991# Argonne National Lab., Ill. Physics Div.
WHADDAYADOO WITH THE DIDJERIDOO?—A GENERALIZED ASI-2100 PROGRAM FOR HANDLING DATA FROM THE ND-160 PULSE-HEIGHT ANALYZER

D. S. Gemmell Jan. 1965 51 p refs
(Contract W-31-109-ENG-38)
(ANL-6993) CFSTI: $3.00

The DIDJERIDOO utility program for use with the PHYLIS computing system is described. The purposes of 50 subprogram functions are explained, and detailed instructions are given on how to use them with PHYLIS. The program is intended for physicists working with a tandem Van de Graff accelerator, to provide them with a flexible means of handling data from experiments with the ND-160 pulse-height analyzer. The program enables the physicist to choose subprogram functions and prescribe the order in which they will be performed on the input data. Use of DIDJERIDOO is illustrated with examples in which a 64 X 64-channel spectrum from the pulse-height analyzer is printed out, a dump printout is produced for a single-parameter 512-channel spectrum, and in which a proton and gamma-ray energy experiment is analyzed. J.M.D.

N65-23018# Los Alamos Scientific Lab., N. Mex.
AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. III: COMPARISON OF EQUIVALENT REFLECTIONS
R. B. Roof, Jr., D. T. Cromer, and A. C. Larson 6 Apr. 1965 34 p *ref*
(Contract W-7405-ENG-36)
(LA-3233) GFSTI: $2.00

The procedures employed and the computer program used to compare and average the experimental intensities obtained for crystallographic equivalent reflections are described. The program performs this comparison for data in any of the 230 space groups. Output is a magnetic tape containing an asymmetric unit of data. This tape may be used in a Fourier series analysis or a general least-squares refinement of the crystal structure. Author

N65-23091# Tufts Univ., Medford, Mass.
COMPUTER SIMULATION MODEL FOR ORGANIZATION THEORY
Thornton B. Roby [1964] 78 p refs
(Contracts Nonr-494(15); AF 19(628)-2450)
(TR-8; AD-611870)

A theoretical discussion is presented on the utilization of computers in analyzing organization theory. The computer simulation model is considered a novel and unique theoretical tool. Three aspects of the model are considered: the structure of the initial nucleus from which the model is refined and elaborated; the substantive elements or building blocks of which the model is constructed; and the language in which the model is couched. The process of testing and revising the computer model, and its relationship to empirical data, are discussed. A four-stage testing process is outlined; internal testing, initial tests of ad hoc validity, tests of extended validity or generalizability, and process evaluation. TAB

N65-23120# Illinois Univ., Urbana. Radiolocation Research Lab.
A DIGITAL TECHNIQUE FOR THE MEASUREMENT OF PHASE ANGLE
William G. Steiner Jan. 1965 59 p refs *Its* RRL Publ. No. 272
(Contract Nonr-1834(02))
(TR-26; AD-612146)

A digital technique for the measurement of phase angle is presented. Although the method is completely general, a particular model is designed to measure in 100 μsec the phase angle between two 250-kc input signals which range independently between 50 mV and 10 V rms in amplitude. The measurement is indicated electronically by means of 16 parallel output signals and visually by means of 4 Nixie indicator lamps. Also included are a statistical analysis of the effect of random noise on accuracy and an evaluation of a portion of the phasemeter which was actually built and tested. Author

N65-23207*# Bendix Corp., Teterboro, N. J. Eclipse-Pioneer Div.
REMOTE PROGRAMMABLE POSITION CONTROLLER Final Report, May 1963–Feb. 1964
Mark Gitlin 20 Apr. 1964 25 p
(Contract NAS8-5346)
(NASA-CR-62506) CFSTI: HC $1.00/MF $0.50

The remote programable position controller described consists of two panels: a tape reader, and a mode panel. The tape reader feeds the information read on the programed tape into the mode panel which converts this information into error signals which are fed into the electronics of the servoed three-axis test stand, thereby positioning the gimbals. In addition, the mode panel houses the modulators and level detectors used when the stand is to be operated in the guidance signal processor mode. The control for switching between the two modes is located on the mode panel in such a way that switching into either position disconnects the normal slewing mode. The system was installed at Marshall Space Flight Center, is operating satisfactorily, and is meeting all the original specifications and design requirements. M.P.G.

N65-23246# Chicago Univ., Ill. Labs. for Applied Sciences
A TAPE-TO-PLOTTER CONVERTER
R. A. Semmler and J. F. Tribby Sep. 1964 50 p Suppl. to COO-712-89
(Contract AT(11-1)-712)
(COO-712-88; COO-712-89) CFSTI: $3.00

A tape-to-plotter converter for use with punched paper tapes prepared by a Nuclear Data Model 130A multichannel analyzer is described. The converter reads three BCD digits from the tape, and generates both linear and logarithmic analog voltages for plotting. Relays are used for the 12-bit memory, and a stepping switch is used to accomplish much of the pulse routing and logic. Circuit diagrams are included. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-22211# Warnecke Electron Tubes, Inc., Des Plaines, Ill.
RESEARCH AND DEVELOPMENT PROGRAM FOR X-BAND CROSSED-FIELD AMPLIFIER Quarterly Engineering Report, 12 Sep.–12 Dec. 1964
B. Giltner et al Washington, Navy Dept. [1964] 55 p refs
(Contract NObsr-89504)
(AD-612077)

The theoretical portion of this report reviews the equations for steady electron flow of an ideal laminar beam under conditions of crossed electric and magnetic fields. Taking account of the space charge in the beam and also the presence of a sole

which is negative with respect to the cathode, cold tests have been made on a full-scale line deposited on sapphire, and also on an S-band line deposited on bakelite. Measurements of propagation, attenuation, and matching are being made in S-band considering both symmetrical and anti-symmetrical modes. Beam test measurements of the optics have been made at full scale to check the performance of the emitter and of the gun, and to compare these results with calculations. Further, the transmission of the beam has been measured and the power which reaches the collector has been measured by means of a water calorimeter. The technological part of the work has been concerned with the brazing of the sapphire support of the delay line onto a block for water cooling without supports liable to cause breakage or to deformation of the sapphire. It appears that alumina allows brazing in spite of negative results of tests. TAB

N65-22217# Microwave Associates, Inc., Burlington, Mass.
BROADBAND MICROWAVE SOLID-STATE SWITCHES Final Report, 24 Jun. 1963–31 Jan. 1965
L. Nathanson [1965] 89 p refs
(Contract NObsr-89463)
(AD-611849)

Theoretical aspects pertaining to diode characteristics and behavior, and diode switch design including low pass filter design, quarter-wave transformer theory, and biasing methods are presented. The high power considerations discussed refer to both diode voltage breakdown and diode temperature response. Also included are the final design information and final experimental results of the L/S-band (1-4.5 Gc/s), C-band (4-7.5 Gc/s), and X-band (7-11 Gc/s) switches. Author

N65-22223# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
RESEARCH AND DEVELOPMENT OF SILICON CONTROLLED RECTIFIERS FOR HIGH FREQUENCY AMPLIFIER APPLICATIONS Quarterly Progress Report, 16 Oct. 1964–16 Jan. 1965
[1965] 42 p refs
(Contract NObsr-91299)
(QPR-1; AD-611178)

The factors affecting the design and performance of high-power, high-frequency silicon controlled rectifiers are discussed in detail. The inter-related problems of

$$\frac{di}{dt} \cdot \frac{dV}{dt}$$

turn-off time, turn-on time, current rating, and voltage blocking capability are reviewed, and the technical approach to their balanced solution is outlined. Author

N65-22240# Naval Ammunition Depot, Crane, Ind.
INFORMATION ON MICROELECTRONICS FOR NAVY AVIONICS EQUIPMENT μ-Notes No. 10
1 Feb. 1965 126 p Prepared jointly with U.S. Naval Air Development Center
(AD-612060)

Information on evaluation, application, and availability activities pertaining to state-of-the-art circuits, devices, and materials is given. All information is of similar nature in order to provide logical grouping and easy location of articles. G.G.

N65-22243# Field Emission Corp., McMinnville, Oreg.
DEVELOPMENT OF A MILLIMETER WAVE GENERATOR USING A FIELD EMISSION CATHODE Final Report, 1 Nov. 1962–30 Apr. 1964
J. P. Barbour and F. M. Charbonnier Griffiss AFB, N. Y., RADC, Feb. 1965 37 p refs
(Contract AF 30(602)-2872)
(RADC-TDR-64-475; AD-613191)

A feasibility study is described for the development of electron guns with field emission cathodes, and of the application of these guns to microwave and millimeter wave oscillators. Experimental data were obtained with both coated and uncoated tungsten emitters, and also with several electron gun configurations. Data were obtained at both X-band (10 Gc) and at 70 Gc. Two X-band models of the 1-3/4 mode FDTK were successfully operated. Good agreement was obtained between the calculated and measured values of beam conductance required to start oscillations. A peak power output of 16 W was obtained. It was determined that a short magnetic lens was the focusing best suited for the 70 Gc oscillator. A zirconium-coated tungsten cathode was used so that all of the emitted beam would be well within the 20° to 25° acceptance angle of the lens. The beam conductance was increased by spacing gridless decelerating electrodes along the converging portion of the beam. The potential distribution on these electrodes was such that the beam voltage was decreased by a factor of four prior to entering the cavity. Author

N65-22269 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
A TWO-MILLIMETER BACKWARD-WAVE OSCILLATOR
D. R. Gunderson and R. W. Grow *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 49–50 (See N65-22265 12-10)
(Contract AF 33(657)-8677)

The feasibility of using a high current density, magnetically focused electron beam in a single ladder backward wave oscillator at millimeter wavelengths was investigated. Since the output of a backward wave oscillator is at the gun end of the tube and because of the stringent requirements of the pole piece required by the electron gun, three different bends (plane, 2-bend, and stepped) were designed, built, and tested over the scaled frequency band of 11.6 to 12.5 kMc. Several new approaches were tried for matching to the ladder structure. It was found that by feeding energy directly over one side of the ladder plane of the X-band circuit model, a reasonable match was obtained. A++ orientation of exciting waves was obtained by splitting the single waveguide into two separate guides and rotating each guide one-quarter turn in opposite directions. In addition, tapering the slot width of the ladder gradually from a pure waveguide to the ladder structure resulted in a VSWR of less than 1.9. Reflection data for the three right-angle bends is presented. A 2-millimeter oscillator is being constructed as part of the investigation. S.C.W.

N65-22301 Army Electronics Labs., Fort Monmouth, N. J.
HYDROGEN SYSTEM DEPENDENCE ON DISCHARGE PARAMETERS
S. Schneider, J. E. Creedon, and N. L. Yeamans *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 331–344 refs (See N65-22275 12-34)

The relationship between discharge conditions and the dynamic pressure variations was determined. In addition, it was established that the phenomenon varies directly with the production of atomic hydrogen during the discharge. Further, in the course of the experiment, lateral shifts in the curve describing the behavior of dynamic occlusion under discharge conditions were observed. Since the fundamental relationships to the discharge parameters remained the same, it was assumed that the shifts were due to differences in the nickel. A series of experiments were therefore conducted to determine

the influence of the physical state of the nickel. A square-root dependence on the power dissipated in the gas was established for the hydrogen–nickel system. Also, a solubility mechanism was found in which the concentration of atomic hydrogen was a significant factor. Therefore, hydrogen occlusion cannot be viewed as just a function of the diatomic gas but must include the generated dissociation product, the monatomic gas. E.E.B.

N65-22302 Frankford Arsenal, Philadelphia, Pa.
OPTIMIZATION OF THE ROTATING REFLECTOR Q-SWITCH
M. Schoenfeld, D. A. Reago, and E. Green *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 345–359 refs (See N65-22275 12-34)

A model is proposed for the rotating reflector Q-switch which is consistent with experiments and provides a useful rationale for optimizing resonator design to obtain maximum single pulse output. Experimental data are presented for a ruby laser in a cavity terminated by roof prism reflectors. This configuration was chosen for use in the range finder to avoid problems of film durability and component alinement associated with the use of dielectric mirrors. The following parameters were investigated for the purpose of obtaining maximum single pulse laser output power with a maximum allowable input energy of 150 joules: (1) the total length of the cavity; (2) the Q-switching rate as measured by the rotation speed of the prism; and (3) the input energy to the capacitor. Results are shown as graphs. E.E.B.

N65-22343# Hughes Aircraft Co., Newport Beach, Calif. Electronic Products Div.
SSB AND VHF CRYSTAL FILTERS Quarterly Report, 15 Sep.–15 Dec. 1964
E. C. Ho and R. H. Tuznik [1965] 89 p
(Contract DA-36-039-AMC-02305(E))
(QR-6; AD-460552)

The design, fabrication, and test results on developmental 10-crystal equimotional and bimotional crystal filters at 10.5 Mc and a ladder crystal filter at 20.0 Mc are presented and evaluated. The first efforts in the temperature compensation of crystal filters involving a study phase have been initiated with a discussion of specifications, factors involved in filter temperature stability, temperature sensitivity considerations and minimization, and statistical aspects of the temperature stability problem. Author

N65-22350# General Electric Co., Syracuse, N. Y. Tube Dept.
DESIGN, DEVELOPMENT, AND FABRICATION OF AN ULTRA-HIGH-RESOLUTION CATHODE-RAY TUBE Final Report, 21 May 1962–1Sep. 1964
K. Schlesinger and E. T. Rate [1964] 191 p refs
(Contract DA-36-039-SC-90726(E))
(Rept.-8; AD-457825)

The 5 in. ultrahigh-resolution (UHR) tube uses a two-spiral optical system for focus and collimation. At 18 kV, it puts an average of 4μA through a spot of 1/3 mil. This resolution is fully preserved within a 4 in. screen diameter by three dynamic corrections: one for focus and two for astigmatism. An analog computer derives these signals from deflection. It uses a new type of product generator called the Roving-Square Tube. Spot-size and shape are measured objectively by a new type of spot dissector, using crossed slits and circular sweep. Errors from phosphor decay are eliminated by subcarrier modulation at 10 Mc. Twelve UHR tubes, plus the magnetic components required to operate them, were constructed. Author

N65-22355*# General Electric Co., Schenectady, N. Y. Tube Dept.
DEVELOPMENT OF HIGH TEMPERATURE, GAS FILLED, CERAMIC RECTIFIERS, THYRATRONS, AND VOLTAGE-REFERENCE TUBES Quarterly Progress Report No. 1, Dec. 15, 1964–Mar. 14, 1965
E. A. Baum [1965] 19 p
(Contract NAS3-6469)
(NASA-CR-54372; G-E-SD-514A) CFSTI: HC $1.00/MF $0.50

An initial thyratron design was completed and is based on the use of pyrolytic impregnated, porous graphite for the anode and grid materials. The present cathode being considered is a porous sintered nickel cathode substrate impregnated with an emissive material and designed to operate at temperatures of 850° to 900° C. The purpose of this design is to establish the soundness of the interelectrode structure and materials concepts as well as optimum xenon loading pressure. Some difficulties were experienced during the final braze of the anode tubulation to the nickel support, resulting in a short circuit to the bottom of the molybdenum cathode cup. This was corrected by adjusting the time cycle of the brazing procedure and the length of the tubulation. Author

N65-22372*# General Electric Co., Schenectady, N. Y.
DEVELOPMENT OF HIGH-TEMPERATURE, HIGH-CURRENT, ALKALI-METAL, VAPOR-FILLED CERAMIC THYRATRONS AND RECTIFIERS Quarterly Progress Report No. 3
A. W. Coolidge 23 Mar. 1965 37 p
(Contract NAS3-6005)
(NASA-CR-54365) CFSTI: HC $2.00/MF $0.50

The purpose is to advance the technology and to provide fundamental design data for high-temperature, high-current, alkali-metal, vapor-type ceramic tubes. The objectives are to conduct a fundamental investigation of the problem areas associated with high-temperature, vapor-type tubes, and to fabricate and test prototype rectifiers and thyratrons to prove the technology and to provide application data for future reference. The investigation is concerned with the fundamental problems and the establishment of the conceptual design of prototype models. Work was completed on devices filled with alkali halides. Cesiated cathode emission was studied with respect to the relation between tube drop and cathode temperature. Also the evaluation of inverse anode current was continued. Hafnium coated and zirconium–carbide coated anodes are compared to bare molybdenum anodes and rubidium vapor is compared to cesium. Consideration is given to materials other than cesium that might provide a suitable vapor pressure and low arc drop for high-temperature tubes. Finally, the use of thoriated tungsten as a cathode material for high-temperature tubes is discussed. Author

N65-22382# Naval Research Lab., Washington, D. C. Electronics Div.
A STUDY OF THE SOOHOO-TYPE FERRITE CUTOFF SWITCH
W. H. Mendenhall, Jr. 15 Feb. 1965 28 p refs
(NRL-6203; AD-612514) CFSTI: $0.75

The characteristics of the Soohoo-type cutoff switch (IRE Trans. Microwave Theory Tech., Vol. MTT-7, No. 3, July 1959, p. 332-6 and 334-5) have been measured at X band. Two types of switch configuration were employed; in one, a single ferrite slab was placed against a waveguide sidewall, and in the other two ferrite slabs were placed against opposite sidewalls. The switch is made to operate between an "on state" (or propagation state) and an "off state" (or reflection state) by application of a transverse magnetic field to the ferrite. This action reduces the effective waveguide width and causes cutoff. Low-power-level switching characteristics were studied as a function

of switch geometry, and a group of switches meeting minimal specifications were selected for study at high-power level. The effect of varying waveguide width, the variety of ferrite used, and the width of the ferrite slab on nonlinear loss were studied at highpeak-power level as a function of applied magnetic field. Some techniques which tended to reduce nonlinear loss were noted. Author

N65-22388# Norwegian Defense Research Establishment, Kjeller.
EXPERIMENTAL INVESTIGATIONS OF PUMPLESS TRANSVERSE-WAVE AMPLIFIERS Scientific Report No. 1
Agne Nordbotten and William Thon 20 Nov. 1964 24 p refs
(Contract AF 61(052)-683)
(E-45; RADC-TR-65-70; AD-612028)

The unexpected gain of the drift-tube amplifier has been reproduced in new experiments. Three tubes demonstrated the correlation between net gain and sidewise gun displacement. No correlation existed between net gain and drift-tube diameter, which is contrary to the beam image pumping hypothesis. The net gain was in excess of 20 dB, but the efficiency was poor. A tentative explanation of the gain mechanism is based upon the proposition that transverse waves were excited in the injection process, and that their rotational power was transferred to the beam wave excited by the rf signal. Author

N65-22405# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM OF NONCONTACT OF ELECTRICAL MACHINES
G. I. Shturman, V. V. Apsit, and A. F. Krogeris 1 Mar. 1965 22 p refs. Transl. into ENGLISH from Beskontaktnyye Elektr. Mashiny (USSR), no. 12, 1961 p 5-22
(FTD-TT-65-124/1+2; AD-612417)

Problems involved in the development and practical application of synchronous and dc contactless machines are discussed. Contactless formation of a magnetic field in the rotor of contactless electric motors and the problem of contactless transformation of electric energy by frequency or type of current in dc motors, is emphasized. Further technological development of special devices with nonlinear elements such as controlled semiconductor rectifiers is discussed as a possible solution to these problems. S.C.W.

N65-22434* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ARRANGEMENT FOR MEASURING THE HALL EFFECT
V. N. Bogomolov 11 Feb. 1965 7 p ref Transl. into ENGLISH from the publ. "Novy'ye Mashiny i Pribory Dlya Ispy'taniya Metallov" Moscow, Metallurgizdat, 1963 p 159-161
(FTD-TT-64-945/1+2; AD-611423)

Described is an installation for measuring Hall's emf by the I and H method, in which on account of element simplification it was possible to avoid certain difficulties and interferences, limiting its sensitivity. TAB

N65-22461# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
DEVELOPMENT OF THE ESM-171 X-BAND COAXIAL MAGNETRON
Edward J. Kaiser Jan. 1965 16 p ref
(ECOM-2550; AD-613169)

This report reviews work to develop the ESM-171 low-power, X-band coaxial magnetron capable of a peak power output of 100 watts, tunable over a frequency range of 8500 to 9600 Mc, and capable of 20% to 30% efficiency. This report describes the design approach for the ESM-171 magnetron, reviews a number of problems encountered in building the test models, and presents data obtained on the test models. Author

N65-22485# Bliley Electric Co., Erie, Pa.
MINIATURE CRYSTAL UNITS FOR SINGLE-SIDEBAND OPERATIONS Quarterly Report, Sep. 1-Nov. 30, 1964
J. M. Wolfskill, Roy Spurlin, and Robert Mouck [1964] 23 p
(Contract DA-28-043-AMC-00148(E))
(QR-2; AD-457951)

This project requires the design of miniature, low-power, glass-enclosed quartz crystal units in the 5- to 20-megacycle frequency range. Problems with mounting paste were encountered, as well as problems in fitting experimental crystals (which had been designed for kovar-ring type holders) into the flame-seal HC-26 holders. An AGC circuit was adapted to the TS-683 test set to enable it to meet the 10-microwatt drive level specified for these units. Transistor oscillators and fixed-frequency multipliers were prepared to facilitate age testing. Author

N65-22515# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
ELECTRON TUBE RESEARCH Eighth Quarterly Progress Report No. 24, 1 Sep.-30 Nov. 1964
N. DeClaris and J. S. Thorp [1964] 92 p refs
(Contract DA-36-039-AMC-00034(E))
(EERL-30; AD-457531)

Experimental results from the links to be used in the band-passed matched filter are given along with a summary of the design and construction of the overall matched filter system. The optimum reception of a known signal imbedded in nonstationary noise is considered in terms of a linear time-varying matched filter. It is shown that the concept of a whitening filter is useful in constructing the optimum receiver. The final design of the adaptive matched filter is presented in block diagram form. The system includes tapped delay lines, diode sampling gates, rc averagers, amplifier, and various control circuitry. An investigation of the system identification problem with random inputs is presented. Matrix equations relating the expansion coefficients of the system impulse response to the expansion coefficients of the input and output correlation functions are given. The concept of complex analytic time functions as used in the radar ambiguity function is discussed. The relationship between a real physical signal to be transmitted and the associated complex function is presented with an example to demonstrate the necessity of properly interpreting the complex time function. Author

N65-22549*# United Aircraft Corp., Windsor Locks, Conn. Electronics Dept.
NONDISSIPATIVE DC TO DC REGULATOR-CONVERTER STUDY Second Quarterly Report, 15 Sep.-15 Dec. 1964
E. Fruchter [1964] 50 p refs
(Contract NAS5-3921)
(NASA-CR-62400; HSER-3084) CFSTI: HC $2.00/MF $0.50

The study included examinations of (1) pulse width variations necessary to control over total input range, (2) frequency variations necessary to control over total input range, (3) square waves sources, (4) power losses in saturated transformers, (5) various system concepts, and (6) rectifying components. Selection of the system concept was made, as were an analysis of output filter section, and a magnetic study to determine frequency of operation. An investigation of rectifying devices was conducted. Parameters affecting diode efficiency were

examined, and the possibility of using germanium transistors as synchronous rectifiers was considered. Finally, the stability of a choke input filter section and its response to various input waveforms was analyzed. Author

N65-22559*# Space Technology Labs., Inc., Redondo Beach, Calif.
X-BAND SOLID STATE SIGNAL SOURCE Special Report
C. B. Coulbourn 15 Jan. 1965 70 p
(Contract NAS8-5205)
(NASA-CR-62380; STL-8411-6003-RU-000) CFSTI: HC $3.00/MF $0.75

A discussion of the arrangement and power budget of the submodules comprising the X-band solid state signal source and of the design, development, and test results of each submodule is presented. This system incorporates a power amplifier at 324 Mc for increased dc to rf conversion efficiency, and was successful in adding the output powers from three separate amplifiers. Power levels of 25 to 30 watts were obtained. The development of frequency doublers operating from L- through X-band permits operation at twice the power levels of corresponding single ended multipliers and seems to include considerable harmonic rejection. It was concluded that obtaining 1 watt at X-band from an all solid state signal source is feasible. Hardware has been developed which has the advanced characteristics necessary for a flight-packaged, flight-proofed high power solid state signal source. G.G.

N65-22666# Microwave Electronics Corp., Palo Alto, Calif.
MEDIUM-POWER, LOW-NOISE TUBE DEVELOPMENT Interim Development Report No. 13, 1 Mar.–31 May 1964
Sep. 1964 19 p
(Contract Nonr-3470(00) (X))
(MEC-QTR-Nonr-3470-13; AD-614222)

Five vacuum envelopes were tested and a tube having all specified electrical performance was subjected to temperature, shock and vibration testing. Author

N65-22681# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
EXPLORATORY DEVELOPMENT OF HIGH RESOLUTION TELEVISION CAMERA TUBES Interim Engineering Report, 11 Sep. 1964–10 Jan. 1965
M. Green and R. R. Beyer [1965] 65 p refs
(Contract AF 33(615)-1271)
(IER-2; AD-612069)

The objective of this program is to develop high performance television camera tubes by exploiting the capabilities of the secondary electron conduction (SEC) storage target. The program is divided into two principal areas. First, it is intended to establish current performance limitations of the SEC target by measuring such parameters as resolution, gain, and capacity. Particular emphasis will be placed on the resolution measurements. Second, attempts will be made to find out how the target, or its mode of operation, may be modified so as to improve overall camera tube performance. Again, special attention will be devoted to achieving better resolution. The two lines of investigation are complementary, and the test equipment and procedures developed for the first part of the program will be used to evaluate any promising target modification devised during the second part. TAB

N65-22706# Westinghouse Electric Corp., Bloomfield, N. J.
DEVELOPMENT OF INFRARED SOURCES Interim Progress Report, 1 Dec. 1964–10 Feb. 1965
N. C. Beese [1965] 10 p
(Contract NObsr-91099)
(NObsr-91099-3; AD-456960)

Several 3-electrode 1800-Watt xenon lamps with concentrated arc and short overall length were constructed, and burned several hours in a marine lantern-type housing using artificial air-cooling. Starting and operating conditions were comparable to the much longer lamps made several years ago. An experimental short-arc xenon lamp was made in which an electromagnet supplied the mechanism for arc ignition with the normal power supply. This lamp has desirable starting characteristics. Author

N65-22751 Army Electronics Labs., Fort Monmouth, N. J.
HIGH POWER MICROWAVE DEVICE APPLICATIONS FOR NEW NARROW RESONANCE LINEWIDTH PLANAR HEXAGONAL FERRITES
Samuel Dixon, Jr., Robert O. Savage, Jr., and Arthur Tauber *In* Army Dept. Army Sci., Conf. Proc., Vol. I [1964] p 261–274 refs (See N65-22732 12-34)

A ferromagnetic resonance linewidth of 3.8 oersteds at 9.0 kMc and room temperature represents a considerable improvement in material technology for hexagonal ferrites with planar anisotropy. The linewidth compares favorably with that found in single-crystal YIG and in lithium ferrite. Investigation shows that the large planar anisotropy endows ZnY materials with several distinct advantages in enhancing the design of microwave devices. The anisotropy field increases the frequency range for the coincidence of the first- and second-order processes, which inherently gives a lower threshold power level. In addition, the anisotropy field tends to decrease the critical field (power level) at which spin-wave instabilities set in. From the measured threshold field, a spin-wave linewidth of 0.74 oersteds was calculated for manganese-substituted ZnY. Further experimental work involving the growth of large crystals and the substitution of other elements, such as aluminum, should make a host of magnetic devices feasible in the millimeter-wave frequency range. Author

N65-22780# Texas Instruments, Inc., Dallas.
MOLECULAR ELECTRONICS FOR RADAR APPLICATIONS Interim Engineering Report No. 1, 1 Oct.–31 Dec. 1964
Philip R. Thomas and Gerard J. Kelly Jan. 1965 81 p refs
(Contract AF 33(615)-1993)
(TI-03-65-22; AD-459540)

System parameters were clarified, and preliminary circuit function requirements defined. A stripline hybrid was fabricated for the mixer circuit, and a discrete component power amplifier circuit was breadboarded, with several integration approaches considered. A thin-film component test circuit for the 500-Mc I-F preamplifier was designed and fabricated, as well as a prototype discrete component breadboard, and a microminiature version. The angle method was selected for the terrain-following computer. In component development, a transistor providing 200-mW output with useful gain of 3 dB was achieved at 2.25 Gc, and surface-oriented diodes are being developed for mixers and signal control switches. Striplines were fabricated on silicon and on ceramic substrates, and flat square coil inductors were fabricated on various substrates with highest Q's (25) obtained on 5000 Ω-cm silicon. Author

N65-22813# Hughes Aircraft Co., Oceanside, Calif.
RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE Interim Development Report, 1 Oct. 1964–1 Jan. 1965

P. P. Damon Jan. 1965 17 p ref
(Contract NObsr-89452)
(AD-611559)

Design and performance data on four 10-inch, 2-color storage tubes which were built during this report period are presented. The phosphor pattern in these tubes consisted of a continuous thin layer of green phosphor overlaid with red europium activated yttrium vanadate phosphor dots. The phosphor dots are registered with the storage mesh holes. Two of the four tubes were gassy and could not be evaluated. The other two were evaluated in the moving target application and performed well. Storage times which considerably exceeded the objective requirements and satisfied the more stringent needs of the moving target application were demonstrated. Color uniformity of the last tube is excellent. This tube, 502X01, has demonstrated the best overall performance of any tube to date. It has better green saturation and longer storage time than tube 435X05 which was produced during the previous quarter. Brightness has been limited because of an arc which occurred between the backing electrode and view screen. Two tubes are being fabricated similar to the last tube, except that the view screen-to-backing electrode spacing has been increased slightly. TAB

N65-22841# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
DEVELOPMENT OF EXPERIMENTAL GAS DISCHARGE DISPLAY Quarterly Progress Report No. 5, 24 Sep.–24 Dec. 1964
Jan. 1965 15 p
(Contract NObsr-89201)
(GRR-65-1017; AD-457611)

Progress was reported for gas mixture experimentation, feedback fabrication, small gas cell display, electrical testing, and vendor contact. Among the specific items reported were data on gas mixture tests. Above 38-mm-Hg pressure, the firing voltage increased but the holding voltage did not. The difference between these two voltages may then be used to advantage. At pressures below 15 mm Hg, the firing voltage rose but became somewhat unstable. The use of a higher concentration of Kr^{85} may be effective in stabilizing this voltage. Further, if no Kr^{85} is used, the establishment of a well defined firing voltage is impossible. The use of Kr^{85} insures the presence of free electrons by its continuous radiation, although some small degree of randomness is always present. It was concluded that the gas conduction display would be operated with a higher gas pressure than 50 mm Hg with 9.45 millicuries of Kr^{85} per liter in the gas mixture. E.E.B.

N65-22878# Naval Ordnance Test Station, China Lake, Calif. Test Dept.
DIGITAL RANGE UNIT THEORY OF OPERATION AND CIRCUIT DESCRIPTION
Kenneth O. Bryant and Sara G. Valdivia Jan. 1965 39 p
(NOTS-TP-3730; AD-612153)

The report describes the experimental digital range unit used with the M-33D radar. The unit, designed and built for use with both the M-33D and Nike–Ajax radar sets, is part of the testing facility constructed at NOTS for the surface launched weapon control exploratory development project. Author

N65-22899# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
THE DEVELOPMENT AND EVALUATION OF A BILATERAL TRIODE SWITCH Quarterly Progress Report, 13 Oct. 1964–31 Jan. 1965
[1965] 45 p refs
(Contract NObsr-91151)
(QPR-3; AD-456845)

This report describes work on development of an improved bilateral triode p-n-p-n switch. A model of the heat flow paths within the device is developed and its feasibility, as well as its applicability to established computer-performed rating procedures is shown. Contacting and mountdown methods are discussed. Author

N65-22942# Weston Instruments, Inc., Newark, N. J.
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Interim Development Report, 1 Sep.–30 Nov. 1964
T. Matley and R. E. Busch [1964] 21 p
(Contract NObsr-87542)
(DR-9; AD-611099)

Temperature gradients resulting from electrical loading were not the fundamental cause of resistance shift or hysteresis. One likely source of contamination, namely, wax from the slicing and dicing operation to produce substrates was not a cause of resistance shift. A better reflux cleaning cycle, however, evolved which allows better quality metallizing as determined visually. The actual cause of resistance shift could not be determined. Porous substrates exhibiting the most uniform structure produce resistors with the smallest % deviation in resistance. An initial investigation of solid impregnants indicates that a broad range of stiffness (modulus of elasticity) of the impregnant material can be successfully employed. Author

N65-22967*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONSTANT AMPLITUDE, VARIABLE PHASE FILTERS
Lonnie Joe Rogers and David S. Hepler Washington, NASA. May 1965 26 p refs
(NASA-TN-D-2758) CFSTI: HC $1.00/MF $0.50

A lossless, constant amplitude, variable phase filter is derived from a general bridge-T network. Certain balance and load conditions are necessary to maintain a constant voltage while changing the phase. By using a voltage variable capacitor, the phase of a sinusoidal voltage can be controlled by the network. The phase response, as a function of voltage, is shown for several specific networks. Examples of methods for altering the phase response of a particular network are demonstrated. An application of the network as a phase modulator for a radiofrequency transmitter is illustrated. Author

N65-22969*# National Aeronautics and Space Administration, Washington, D. C.
TERMINOLOGY OF THE THEORY OF RELAY DEVICES
M. A. Gavrilov May 1965 31 p refs Transl. into ENGLISH of the publ. "Terminologiya po Teorii Releynykh Ustroystv, Inst. Avtomatiki i Telemekhaniki, Tekhn. Kibernetiki" Moscow, 1964
(NASA-TT-F-352) CFSTI: HC $2.00/MF $0.50

This terminology list for the area of the theory of relay devices includes only those terms relating to the basic concepts. An essential difference is drawn between the structural and functional properties of the relay devices and the condition of their operation. Terms relating to the structural properties of the relay devices are defined from actual existing relay devices in which the connections, circuit components, etc. actually exist. Terms relating to the functional properties of the relay devices are defined for models whose elements are the links or blocks corresponding to some elementary function or to a structurally defined portion of a device which performs a definite

function. Considered are relay instruments; general characteristics of relay devices; structure of relay devices; their functional properties; and the analysis and synthesis of relay devices. G.G.

N65-22977# Sandia Corp., Albuquerque, N. Mex. Electronic Components Div.
PROCEDURE FOR THE ANALYSIS OF SEMICONDUCTOR FAILURES
R. D. Solberg Apr. 1965 11 p
(SC-RR-65-137) CFSTI: $1.00

The procedure necessary for an efficient semiconductor failure analysis program is presented. Methods of electrical testing, visual inspection, mounting, polishing, and etching are described. Examples of results obtained are given along with discussions of the problems encountered in the complete analysis. Author

N65-22999# Atomics International, Canoga Park, Calif.
LOW FLUX NUCLEAR RADIATION EFFECTS ON ELECTRONIC COMPONENTS (BMI-LF-2)
M. N. Robinson, S. G. Kimble, N. F. Davies, and D. M. Walker
20 Apr. 1965 146 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10284) CFSTI: $4.00

A series of irradiation experiments on electronic devices intended for SNAP reactor control systems are described. Several diode and transistor types, sensistors, capacitors, and an oscillator from a prototype SNAP 10A Startup Controller were irradiated to 3×10^{15} nvt (>0.1 MeV) and 5×10^{8} r (gamma). Results are presented of inpile measurements of the critical electrical characteristics, in the form of graphs produced automatically by a computer peripheral plotting facility. Author

N65-23025# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
SOLID-STATE DC AMPLIFIER WITH HIGH INPUT IMPEDANCE
Joseph S. Byrd Feb. 1965 16 p refs
(Contract AT(07-2)-1)
(DP-953) CFSTI: $1.00

A solid-state operational amplifier with a field-effect transistor at the input was designed and tested. The amplifier has an input resistance greater than 5×10^{11} ohms and an input leakage current less than 10^{-12} ampere at room temperature. The amplifier is useful in nuclear instrumentation applications where it is necessary to measure very small signal currents. Author

N65-23097# Microwave Electronics Corp., Palo Alto, Calif.
DEVELOPMENT OF TWO X-BAND VARIABLE GAIN TWTs (ONE LOW LEVEL AND ONE MEDIUM LEVEL) Interim Development Report, 1 Oct.–31 Dec. 1964
Norman Berger Feb. 1965 46 p
(Contract NObsr-91341)
(IDR-2; AD-611213)

The generalized method developed for predicting behavior correlates effectively with theory. Of two tubes tested to ascertain the best range of γa for variable gain operation, the lower γa tube provides the best gain control. Two three-helix, variable gain tubes were tested. The gain variation was greater than anticipated, and noise figure and saturated power output exceeded allowable limits. Author

N65-23108# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Tube Research and Development Dept.
DEVELOPMENT OF A SUPER POWER DEUTERIUM THYRATRON Final Report
Nicholas Reinhardt 15 Feb. 1965 44 p ref
(Contract NObsr-89405)
(B-2969; AD-610848)

The design, development, fabrication and evaluation of six super-power deuterium thyratrons are described in detail. TAB

N65-23111# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering
RDT&E COST ESTIMATING FOR AIRBORNE ELECTRONIC EQUIPMENT
Keith A. Erikson Aug. 1964 65 p refs
(GSM/SM/64-6; AD-611274)

The requirement for producing accurate cost forecasts for airborne electronic equipment developmental programs is becoming increasingly important. As a beginning, the estimator must understand all of the major efforts required to bring a new piece of equipment to the point of production. There is good evidence that the weight of the equipment to be developed can be used as a basis for estimating the developmental costs of the equipment. Additional research may produce a highly reliable estimating methodology using weight as the basis. Author

N65-23143*# Sperry Farragut Co., Bristol, Tenn.
DESIGN, DEVELOPMENT, AND FABRICATION OF A SEALED, BRUSHLESS DC MOTOR Final Report
Washington, NASA, May 1965 126 p refs
(Contract NAS5-3582)
(NASA-CR-231) CFSTI: HC $4.00/MF $1.00

In this motor, photo-optical detectors and transistorized switches perform the functions of the conventional commutator without physical contact. The rotor is a permanent magnet. Hermetic sealing of the stator and commutator compartments was specified to eliminate the possibility of bearing contamination by outgassing, in hard-vacuum environments, from insulating materials, plastics, and solder fluxes. The motor also features a rotor-bearing assembly that can be removed as a unit from the front of the motor without disturbing its remaining components. Design goals included a reduction in overall size to approximately one-third of the volume of a 3-watt motor previously produced. The achieved reduction in volume, to 36.5% of that of the previous motor, closely approached the design goal. Also included was a requirement for sufficient improvement in efficiency to offset most of the losses incurred by sealing the motor. The original requirement of 45% minimum efficiency was vastly exceeded in the new design, so that the efficiency obtained exceeds that of a good ac induction motor of comparable performance. Furthermore, the reliability of the motor was to be at least 95% for 1 year. A predicted reliability in excess of 95% for 1 year was achieved. Author

N65-23150# Hughes Aircraft Co., Fullerton, Calif. Nucleonics Research Dept.
PHOENIX MISSILE SYSTEM. TRANSIENT GAMMA RADIATION EFFECTS ON ELECTRONIC SYSTEMS
29 Aug. 1963 154 p refs
(FR-63-17-179; AD-430654)

Summaries on the current state-of-the-art of transient gamma radiation effects on electronics are presented. These

effects are usually the result of electronic processes in the irradiated materials, and can be divided into two categories, charge injection and charge leakage. These include (1) gases—ionization and increases in conductivity; (2) semiconductors—changes in conductivity, increase in minority carrier concentration, production of electron-hole pairs; (3) insulators—decreases in insulation resistance and breakdown strength; (4) emission of electrons from materials by photo and Compton effects; and (5) fluorescence. M.G.J.

N65-23167*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARACTERISTICS OF A 5-KILOJOULE, IGNITRON-SWITCHED, FAST-CAPACITOR BANK
Charles J. Michels and Fred F. Terdan Washington, NASA, May 1965 22 p refs
(NASA-TN-D-2808) CFSTI: HC $1.00/MF $0.50

The electrical characteristics of the bank are a capacitance of 12.1 microfarads, an inductance of 14 nanohenries, a voltage range of 10 to 30 kilovolts, and a resistance of 0.0038 ohm. The bank consists of 11 identical capacitor sections, each synchronously switched with an ignitron. All components hold off voltage to 30 kilovolts for an automatic fast charging mode of operation after a laborious conditioning process. A slower 1/2-minute charging time for manual charging mode limits reliable operation to 25 kilovolts only. Synchronization to within tens of nanoseconds is obtained through the use of a fast, high-voltage trigger signal and ignitron temperature control. Typical transient current and voltage traces, as well as the instantaneous power plots obtained from these traces, are described for each component of one section of the bank with a 150-nanohenry load. Instrumentation, including the adaptation of a commercial voltage probe used in an off-ground high-noise area, is also described. Author

N65-23179# Stanford Univ., Calif. Systems Techniques Lab.
A FIXED-VOLTAGE POWER SUPPLY FOR TRANSISTOR CIRCUITS
David W. Howell Aug. 1964 34 p *Its* Tech. Rept. No. 1807-7
(Contract AF 33(657)-11144)
(SEL-64-096; AFAL-TR-64-264; AD-609447)

Fixed-voltage regulated power supplies are described for use with transistor circuits. Specific circuits are described for regulators supplying 13 to 31 V at currents up to 1 A. Circuit modifications are given which make the basic regulators useful for a wide range of applications. A procedure is developed for evaluating the performance of new regulators. Author

N65-23192*# Microwave Electronics Corp., Palo Alto, Calif.
INVESTIGATION OF SOLID STATE TRAVELING-WAVE AMPLIFIER TECHNIQUES FOR FUTURE SATELLITE APPLICATIONS Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1964
Jan. 1965 33 p refs
(Contract NAS5-3972)
(NASA-CR-62527) CFSTI: HC $2.00/MF $0.50

Tasks include development of improved transducers, elimination of spurious oscillations, evaluation and selection of optimum semiconductor materials, and investigation and evaluation of properties of solid-state traveling-wave amplifier process. Major efforts were devoted to theoretical investigations of microwave amplifier processes and materials and to the analysis of a noise figure measuring scheme. Emphasis was on the development of the conditions for oscillation-free amplification and low noise. The development of thin-film transducers progressed to a satisfactory point; effort was devoted to the analysis of the requirements for an rf impedance matching network to match into the amplifier's acoustic transducers. This network is designed to offer broadband rf coupling. Author

N65-23201# Warnecke Electron Tubes, Inc., Des Plaines, Ill.
STUDY OF INTERACTION STRUCTURES LEADING TO DEVELOPMENT OF X-BAND CROSSED-FIELD AMPLIFIER Quarterly Progress Report, 28 Sep.–28 Dec. 1963
Frank Voltaggio, Jr. 15 Jan. 1964 39 p
(Contract NObsr-89504)
(QPR-2; AD-429472)

Development of a 2-kilowatt CW crossed-field amplifier in X-band includes studies of the following: attenuation characteristics of a meander line mounted on ceramic; cold measurements on full-scale lines in S-band, as well as methods of matching and adapting the structure to the output waveguide; appropriate ceramics for use in X-band lines; technology for producing ceramic delay lines; and measurement of the heat conductivity of a metal–ceramic sandwich. Author

N65-23209*# Acoustica Associates, Inc., Los Angeles, Calif.
SENSOR, FUEL DEPLETION Summary Report, 1 Jul. 1963–15 Mar. 1965
R. W. Remington Mar. 1965 33 p
(Contract NAS8-5431)
(NASA-CR-62593; DO-5872) CFSTI: HC $2.00/MF $0.50

A detailed description of the control unit and the mode of operation of the four basic sections, oscillator, switch driver, output switch, and wet-dry simulator, are discussed along with the radio interference filter, failure mode analysis of the unit, and a section on fluid dynamic characteristics of the sensor. Author

N65-23213*# General Electric Co., Syracuse, N.Y. Semiconductor Products Dept.
RESEARCH TO DETERMINE FAILURE MODES FOR TRANSISTORS Fifth Quarterly Report, Sep.–Dec. 1964
Robert G. Quick [1964] 79 p
(Contract NAS8-11059)
(NASA-CR-62505) CFSTI: HC $3.00/MF $0.75

A detailed analysis of failure modes shows that planar transistors are subject to failures due to transient spikes. This failure mode causes serious damage if the transistor is not limited against thermal runaway. This mode of failure is most prevalent among transistors which are considered least likely to have channeling modes of failure. Preliminary computer readout of distribution of values is included. This readout is not corrected for the combined effect of computer, data processing, and automatic reading error. The 250 readings on each transistor cause indicated failures to be several times actual. Author

N65-23217# Microwave Chemicals Lab., Inc., New York.
[DEVELOPMENT OF X-BAND REMANENCE PHASE SHIFTERS] Final Report, Apr. 22, 1963–May 1964
E. Stern and A. Christopher 28 May 1964 73 p Prepared for Lincoln Lab., Mass. Inst. of Tech., Lexington
(Contract AF 19(628)-500)
(AD-611557)

A successful technique was devised for the design and construction of composite magnetic loop structures. Microwave circuit designs were found which provide good performance and at the same time match into composite loop structures. One square loop material was developed with properties suitable for temperature stabilization of phase shifters. The first attempt to assemble a phase shifter was not successful. TAB

N65-23219# Oklahoma State Univ., Stillwater. Graduate School
SEPARATION CRITERIA OF A NONLINEAR CONTACT SYSTEM IN A STEADY STATE SINUSOIDAL VIBRATION ENVIRONMENT
Morris Charles Burkhart (Ph.D. Thesis) May 1965 84 p refs
(AD-611783)

A preloaded, idealized set of contacts with a hardening nonlinear restoring element was studied to determine the separation criteria when the set was subjected to a steady state sinusoidal excitation. The criteria were determined theoretically for an undamped set of contacts; the effect of damping on the undamped criteria was studied qualitatively; selected undamped criteria were tested experimentally and the effect of a nonlinear jump response on the theoretical separation criteria was investigated experimentally. The study covered several degrees of nonlinear restoring forces and included the separation criteria of a linear set of contacts as a special case. The separation criteria were determined solely by the contact configuration and preload. The contact response amplitude for nonseparation varies from zero to large values, depending on the contact configuration. The configuration of one rigid and one flexible contact permitted on response-amplitude without separation while a linear configuration where each contact had the same natural frequency theoretically permits unlimited nonseparation amplitude. An increase of the nonlinearity of the hardening nonlinear restoring element decreased the allowable nonseparation response amplitude. TAB

N65-23221# Litton Industries, San Carlos, Calif. Research Lab.
HIGH PERVEANCE GUN STUDY Quarterly Progress Report, 1 Mar.–31 May 1964
M. Hanley, A. Mizuhara, and F. Lee 20 Jun. 1964 30 p
(Contract DA-36-039-SC-87313)
(QPR-12; AD-462074)

The construction of a 100-kV inverted magnetron injection gun and mating klystron body is described. The inverted gun design is part of a high perveance gun study in which increased gun convergence is to be obtained by placing the gun in a converging magnetic field. The inverted design permits a larger angle of intersection between magnetic field lines and cathode surface, with an expected decrease in noise figure. Author

N65-23222# Army Missile Command, Huntsville Ala. Inertial Guidance and Control Lab.
A SWITCHING MODE SERVO AMPLIFIER USING PULSE WIDTH MODULATION
Harold V. White and Herbert R. Mc Carley 1 Apr. 1965 31 p refs
(RG-TR-65-5; AD-461660)

This report presents a discussion of a pulse-width-modulated power amplifier for servo loop applications, particularly inertial platform stabilization loops. Description, mode of operation, and advantages of the amplifier circuit are given. Pertinent mathematical and laboratory test data are also included. Author

N65-23241# Army Electronics Labs., Fort Monmouth, N. J.
CATHODE-GRID PHENOMENA IN HYDROGEN THYRATRONS
J. E. Creedon, S. Schneider, and F. Cannata Dec. 1963 17 p ref
(USAELRDL-TR-2410; AD-430277)

The performance of the grid-cathode region of hydrogen thyratrons was investigated at pulse lengths of 5, 30, and 1000 microseconds. Experimental results of current capabilities are discussed for several tube types. Cathode arcing phenomena are empirically related to the cathode-coating resistance, and voltage breakdown values are deduced for various pulse lengths. Performance of the hydrogen thyratron as a switching device for millisecond pulses is discussed. Author

N65-23260# Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Lab.
OPERATION OF DISTRIBUTED CONSTANT NEURISTOR ELEMENTS
D. R. Zimmerman (M.S. Thesis–Rensselaer Polytechnic Inst., Troy, N. Y.) 4 Feb. 1964 25 p refs
(NADC-EL-6374; AD-430216)

The effects of a distributed power supply layer on the operation of a neuristor device are reported. Equations are derived which approximate the operating characteristics of a neuristor based on a generalized negative-resistance phenomenon propagating by means of carrier diffusion. The results and the theory are discussed from the standpoint of limiting factors controlling neuristor stability and propagation velocity in silicon. Author

N65-23274# Army Electronics Labs., Fort Monmouth, N. J.
QUALITY ASSURANCE PAMPHLET: STANDARDS OF WORKMANSHIP FOR WIRED EQUIPMENT
Feb. 1964 80 p
(AMSEL-P-715-600; AD-612054)

The pamphlet was prepared as a guide to the standards of workmanship desired by the U.S. Army Electronics Command in wired equipment procured for the military arms. It is intended that these standards be used primarily in the inspection and acceptance of material under U.S. Army Electronics Command contracts. They will increase uniformity in judging defects by narrowing the individual variability of QAREPS in classifying material submitted for inspection as defective or acceptable. TAB

N65-23302# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
STABILIZATION OF THE CURRENT IN TRANSISTOR POWER SYSTEMS [STABILIZZAZIONE DELLA CORRENTE IN SISTEMI DI POTENZA A TRANSISTORI]
M. Avaltroni and M. Coli 23 Mar. 1965 15 p refs In ITALIAN *Its* Nota Interna No. 277
(LNF-65/9)

A stability analysis of a 20-kW transistorized power pack included investigation of the regulation of output current and stability under very short duration, short duration, and at steady-state conditions. Specifications listed include output current from 0 to 30 A; output voltage 0 to 35 V; stability 0.0005 by varying 20% of the network; stability 0.0003 by varying 100% of load; stability 0.0005 by varying ambient temperature from +10 to +45° C; and ripple-to-noise ratio 10^{-6} of maximum output. Transl. by P.F.E.

N65-23309# Missouri Univ., Columbia.
SYNTHESIS OF FEEDBACK SYSTEMS
Charles Robert Leo Hausenbauer (Ph.D. Thesis) Ann Arbor, Mich., Univ. Microfilms, 2 Aug. 1957 158 p refs

This study sets forth a quick and accurate procedure of feedback control system synthesis developed to eliminate or avoid difficulties encountered in carrying out the details of the Guillemin method of system synthesis. Attention is confined to the

synthesis of linear, continuous, unity-feedback control systems from a set of closed-loop transient and steady-state performance specifications to an appropriate open-loop transfer function, $G(s) = G_1(s)G_2(s)$. The fixed portion of the system $G_2(s)$ is a type I system that is compensated by the transfer function $G_1(s)$ consisting of resistant-capacitor elements only. Author

N65-23314# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
ALKALI METAL RESISTANT WIRE Quarterly Report, Nov. 15, 1963–Feb. 15, 1964
E. S. Bober, W. H. Snavely, and R. E. Stapleton 15 Feb. 1964 56 p
(Contract AF 33(657)-10701)
(AD-430220)

Effort was directed toward development of an insulated electrical conductor resistant to saturated potassium (850° C) and mercury (538° C) vapors. Thirty-three samples were exposed to potassium vapor at 850° C; six to mercury vapor at 540° C. Preformed coils of nickel clad silver were coated with molybdenum and nickel aluminide, respectively, by plasma-arc spraying techniques. These coils were then insulated by plasma-arc sprayed coatings of zirconia (99%), followed by high purity alumina (98%). Vibration, shock, acceleration, and humidity tests were conducted on these insulation combinations in a statorette. The tests were passed by the insulated wire. A partly successful attempt was made to measure the leakage resistance of sapphire to tantalum seal while the seal was exposed to potassium vapor at 850° C. Results indicate potassium vapor at 850° C will not act as a conductor. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-22246# Polytechnic Inst. of Brooklyn, N. Y.
NETWORK SYNTHESIS WITH TRANSMISSION LINE ELEMENTS
Herbert J. Carlin Griffiss AFB, N. Y., RADC, Feb. 1965 116 p refs
(Contract AF 30(602)-2868)
(PIBMRI-1235-64; RADC-TDR-64-505; AD-612596)

The work consists of two parts. In Part I a technique for the realization of cascaded commensurate transmission line networks of uniform propagation constant is presented directly in terms of the scattering formalism without recourse to impedance representations by applying Richards' transformation. Necessary and sufficient conditions for realizability are presented and applications to transformers, linear phase systems, and low-pass filters are given. In Part II realizable band-pass (zero of transmission, i.e., infinite loss, at dc) equiripple gain functions are constructed which permit physical realization of systems consisting of cascaded lines and stubs. The method is illustrated by designs of filters, as well as a new form of broad band transformer in which the low frequency response is suppressed by a shunt stub. Author

N65-22247# Sperry Gyroscope Co., Great Neck, N. Y.
TRANSIENT BEHAVIOR OF LARGE ARRAYS
G. F. Ross, L. Susman, and J. Hanley Griffiss AFB, N. Y., RADC, Feb. 1965 92 p refs
(Contract AF 30(602)-3348)
(EB-5287-0500-2; RADC-TDR-64-506; AD-612567)

This report contains the results of the second phase of a theoretical and experimental investigation of the transient behavior of microwave components used in feed networks of large antenna array systems. In particular, it was found that the techniques used for analyzing TEM mode components during the first phase can be extended to the analysis of combinations of TEM mode components. However, as the complexity of the combined networks increases, it becomes necessary to approximate the exact solutions by neglecting certain interactions. Various combination networks treated include cascade connections of power dividers, switches, ring hybrids, and directional couplers. Author

N65-22251# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
ULTRA HIGH POWER TRANSMISSION LINE TECHNIQUES Sixth Quarterly Report
John P. Quine and C. Younger Griffiss AFB, N. Y., RADC, Mar. 1965 65 p refs
(Contract AF 30(602)-2990)
(RADC-TR-65-7; AD-613953)

The purpose of this investigation is to develop systematic procedures for selecting optimum waveguide configurations and designing waveguide components that will operate at high levels of peak and average power in the frequency range 1 to 10 gigacycles. The feasibility of designing compact components in waveguides having cross-section dimensions in the range 1.5 to 2.5 free space wavelengths is investigated. Analysis of multihole side wall couplers is continued. Theoretical data are presented for constant curvature E-plane bends. The results of mode conversion measurements are presented for a 40-in. straight taper, a 24-in. variable curvature taper, and a full oversized H-plane bend having R/a equal to 1.48. The results of a study of mode conversion at waveguide flanges are also presented. Author

N65-22254# University of Southern Calif. Engineering Center, Los Angeles. Electronics Sciences Lab.
JOINT SERVICES ELECTRONICS PROGRAM Final Report, 1 Sep. 1963–1 Sep. 1964
[1964] 69 p refs
(Grant AF-AFOSR-496-64)
(AFOSR-65-0390; AD-612039)

Fundamental investigations in solid state physics reported included the infrared properties of InAs and CdTe at room temperatures; the theory of phonon assisted tunneling in semiconductors; the growth of single crystals of $BaAl_{12}O_{19}$ and similar compounds doped with iron; crystal imperfection in Al_2O_3, AgBr, and CdS; superconductivity in thin films as microwave circuit elements and in high field; and magnetism. Also, wave propagation in hot-plasma waveguides; propagation studies; and characteristics of current carrying and ionized plasmas are reported. Further, the continuous identification of dynamic system parameters using analog computer techniques is discussed. Emphasis in bioelectronics was on parameter optimization procedures. Blood flow and pressure data were recorded on magnetic tape and a model of the blood flow in the ductus arteriosus was simulated on the analog computer and optimized using gradient methods. Finally, coding theory for Gaussian channels and for English as a second order Markov source was investigated. E.E.B.

N65-22265# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
MICROWAVE DEVICE AND PHYSICAL ELECTRONICS LABORATORY CONSOLIDATED QUARTERLY REPORT
Technical Report, Oct. 1–Dec. 31, 1964
31 Dec. 1964 126 p refs
(Contracts AF 04(693)-439; DA-36-039-AMC-02372(E), Nonr-1288(05))
(MDL-Q11; AD-612954)

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N65-22266 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
ROTATING BEAM DEVICES
R. L. Schriever, C. H. Durney, and C. C. Johnson *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 4–13 refs (See N65-22265 12-10)
(Contract AF 33(657)-8677)

Coupling processes between rotating electron beam modes and circuit modes were investigated. Using coupled mode equations for a thin hollow rotating beam in a waveguide, the relative importance of the coupling of longitudinal modes to the circuit mode and the coupling of the transverse modes to the circuit mode were determined. A comparison was made of coupling effects for both cases and for the composite case to determine which type of interaction is most important as a gain mechanism. S.C.W.

N65-22267 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
MULTIPLE-BEAM INTERACTIONS
D. Christensen, C. H. Durney, and R. W. Grow *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 15–31 refs (See N65-22265 12-10)
(Contract AF 33(657)-8677)

The feasibility of using the interaction between multiple electron beams occupying the same space to build millimeter-wave amplifiers and oscillators was studied. A field solution for wave interactions in a system of two intermixed electron beams with different dc velocities was accomplished using polarization variables in order to more easily handle the scalloping boundary configuration at the beam edge. This field solution was then specialized to the case of an infinite geometry and the resulting determinantal equations were solved graphically. Double electron stream in finite geometry was also investigated using Eulerian variables to calculate a finite magnetic field and ac space charge fields. Results show that once the derived current expressions are substituted, the curl H equation could not be written in the form $\Delta \times \bar{H} = j\omega\bar{\bar{\epsilon}} \cdot \bar{E}$ where $\bar{\bar{\epsilon}}$ is some permittivity tensor. This is attributed to derivative operators appearing in the current expressions. A discussion on problems involved in the derivation of permittivity tensors is presented. S.C.W.

N65-22268 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
TRANSVERSE BEAM WAVES
C. H. Durney and C. C. Johnson *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 32–48 refs (See N65-22265 12-10)
(Contract AF 33(657)-8677)

A study designed to extend the analytical description of transverse beam waves and their coupling properties is presented. A corrected set of coupled mode equations for a thin hollow rotating beam in a waveguide were derived using expressions, not involving derivatives, obtained from beam mode equations for certain terms in circuit mode equations. These small signal equations are accurate within the perturbation approximation and are consistent with the small signal power theorem. A set of coupled mode equations for a thick rotating beam in a waveguide with only one of the a_{n+} or the a_{n-} modes present were also derived. In addition to the perturbation assumption, the assumption that $a_{n-} = 0$ was made in obtaining these equations. S.C.W.

N65-22413# Case Inst. of Tech., Cleveland, Ohio.
LOGIC OF CONTROLLED THRESHOLD DEVICES Final Report
E. F. Klock and R. D. Haney Griffiss AFB, N. Y., RADC, Feb. 1965 150 p ref
(Contract AF 30(602)-2518)
(RADC-TDR-64-173; AD-613060)

The synthesis of threshold logic circuits from several points of view is presented. The first approach is applicable to resistor-transistor networks in which the outputs are tied to a

common collector resistor. In general, fewer threshold logic gates than nor gates connected to a common collector resistor are required. Synthesis techniques based upon the use of Boolean matrices are presented. In this case the goal of the synthesis is a network to realize a specified function such that the failure of any but the output gate can be compensated for by a change in the threshold level (and possibly changes in the weights of the inputs). In general, the ability to compensate for a failure requires the synthesis of a network with more gates than if no compensation were required. The net result is that the synthesis is an involved procedure. A mechanism for changing weights of threshold gates using a photodiode matrix is presented. The design of the control system for an IBM type 350 disc file is presented as an illustration of the design of a practical system in which threshold logic is employed. The function of the control system is to position the read-write heads over the specified track of a specified disc to read in or to read out data. Less logic circuitry is required if threshold logic rather than nor logic is used. Author

N65-22426# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON EMISSION FROM DIELECTRIC LAYERS DURING THE PRESENCE IN THEM OF A STRONG ELECTRICAL FIELD (CONTEMPORARY STATE OF THE ART)
D. V. Zernov and N. L. Yasnopol'skiy 11 Mar. 1965 33 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 11, 1964 p 1903–1919
(FTD-MT-65-11; AD-613466)

The article considers the possible mechanisms of electron emission from dielectric layers deposited on a metallic base, in the presence in them of a strong electrical field. On the basis of consideration of totality of data given in literature, the conclusion is made that, depending upon actual conditions, the mechanism of emission can have different nature (tunnel effect, avalanche reproduction of electrons in the layer, etc.). In connection with this, results are discussed of early investigations of the Malter-effect. TAB

N65-22431# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF STABILIZING THE POWER OF ULTRAHIGH FREQUENCY OSCILLATIONS
Yu. K. Pozhela and S. P. Kal'venas 15 Feb. 1965 5 p Transl. from Russian Patent no. 156978 (Appl. no. 724160/40–23, Mar. 30, 1961) 2 p
(FTD-TT-64-916/1+2; AD-611524)

A semiconductor plate with injecting and ohmic contacts is placed in the waveguide, parallel to the electric field vector, between the uhf generator and a transient type power level detector. The uhf power is stabilized by varying the current which passes through the semiconductor plate in a straight direction. This current is controlled by a signal from the power level detector. TAB

N65-22432# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PELLICULAR ELECTRONICS
F. Staros and M. Likhachev 4 Feb. 1965 12 p Transl. into ENGLISH from Radio (Moscow), no. 1, 1964 p 18–20
(FTD-TT-64-921/1+2; AD-611526) CFSTI: $1.00

The method of manufacturing multilayer pellicular elements through vacuum deposition is discussed for a multilayer multivibrator. Thermal evaporation by heating with a current can be applied for substances whose melting point is below the melting point of the evaporizer material. Electron heating is used for evaporation of high melting materials. The use of an ion beam for film depositions has many advantages but requires an ion current of the order of 10 mA. The development of triodes based on field control resulted in transistors that function at positive and negative bias on the gate. Pellicular electronics has the following advantages: (1) It reduces the overall dimensions of equipment. (2) It allows for simultaneous application of a greater number of elements. (3) It reduces the amount and volume of element connections. G.G.

N65-22518# Purdue Univ., Lafayette, Ind. Quantum Electronics Lab.
D. C. POLARIZATION IN A NONLINEAR DIELECTRIC MEDIUM AT OPTICAL FREQUENCIES Semiannual Technical Summary Report No. 1, 1 Apr.–31 Dec. 1963
Mahadevan Subramanian and A. K. Kamal Feb. 1964 93 p refs
(Contract Nonr-1100(24); ARPA Order 306-62; Proj. Defender) (TR-EE-64-5; AD-433218)

The dc polarization that is developed in a nonlinear dielectric medium when a high intensity laser beam propagates through is investigated. The nonlinear dielectric medium chosen is crystalline quartz. The relationship between laser intensity and dc polarization is established mathematically for two cases of propagation. The linear relationship between the laser intensity and the dc voltage output of the quartz detector is verified. The possibility of using this principle to build a transmission type of meter for measuring power in high power laser pulses is presented. Author

N65-22629# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATISTICAL METHODS OF RESEARCH Selected Articles
31 Dec. 1962 46 p refs Transl. into ENGLISH from the publ. "Statisticheskiye Metody Issledovaniya, Teoriya Struktur, Modelirovaniye, Terminologiya, Obrazovaniya" Moscow, Izd. Aked. Nauk SSSR, 1961 p 106–124, 357–367
(FTD-TT-62-1192/1+2+4; AD-294528)

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1. JOINT STABILITY AND QUALITY CONTROL AND ITS APPLICATION IN STATISTICAL DYNAMICS J. Nélolny and J. Beneš p 1–26 refs (See N65-22630 12-10)
2. MECHANIZATION OF ANALYSIS AND SYNTHESIS OF RELAY APPARATUS V. G. Lazarev and P. P. Parkhomenko p 27–43 refs (See N65-22631 12-10)

N65-22630 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOINT STABILITY AND QUALITY CONTROL AND ITS APPLICATION IN STATISTICAL DYNAMICS
J. Nelolny (School of Transportation Machine Construct., Prague) and J. Benes (Inst. of Inform. Theory and Automation, Prague) *In its* Statist. Methods of Res. 31 Dec. 1962 p 1–26 refs (See N65-22629 12-10)

This report shows the possibility of supplementing the Routh–Schur reduction of the denominator of a transfer function by similar reduction of the numerator of the transfer function, and also use of the obtained coefficients for simple calculation of the square area of an impulse function and the square area of the reaction for a unit step without calculating high-order determinants. Two methods for reduction of the numerator were developed, and their applicability for minimization of square areas was studied. The proposed method can also be used for calculating the root-mean-square error of the control loop

on which a stationary random process acts. A method is proposed for approximate calculation of the root-mean-square error. The Laguerre coefficients established for each model of a random process with an orthogonal analyzer using Laguerre modulators are used for the approximation. A circuit for high-speed automatic calculation by the method of a two-channel iterative process is developed. Author

N65-22631 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANIZATION OF ANALYSIS AND SYNTHESIS OF RELAY APPARATUS
V. G. Lazarev and P. P. Parkhomenko *In its* Statist. Methods of Res. 31 Dec. 1962 p 27–43 refs (See N65-22629 12-10)

Use of computers for structural analysis of relay circuit designs is recommended. When a multistage circuit is represented in the form of its single-stage equivalent and is partitioned into a linear function of its components, algorithms can be written for computer determination of the time sequence of actions by the elements of the multistage circuit. This simplified approach to relay circuit analysis can be applied to automation of quality control in production of electrical devices. Difficulties in finding computer methods for structural synthesis of relay circuits are discussed. J.M.D.

N65-22689# Aerospace Corp., El Segundo, Calif. Control Systems Dept.
A GRAPHICAL METHOD FOR THE DETERMINATION OF GAIN SCHEDULING FOR BOOSTER VEHICLES
T. C. Coffey 14 Oct. 1964 24 p
(Contract AF 04(695)-469)
(TOR-469(5540-10)-2; AD-612155)

A graphical technique is presented for the scheduling of ballistic missile autopilot forward-loop gain during the boost phase of flight. The procedure discussed provides an exact method for determining the "best" piecewise constant gain scheduling for the cases of one and two gain changes. The "best" piecewise constant gain scheduling is taken to be that scheduling which maximizes the minimum gain margin incurred during the times of flight considered. The existence and uniqueness of "best" gain schedules for the case of more than two gain changes is also discussed. Methods for extending the technique of this paper to situations where there exists uncertainty in the knowledge of critical gain boundaries and where the upper and lower gain margins are to differ in magnitude are presented. Although this presentation has been made rather long by the desire to justify the graphical constructions employed, the actual constructions themselves require only a very short time to execute. It is hoped that the results of this paper will prove useful to the controls engineer involved in autopilot synthesis. Author

N65-22796# Aerospace Corp., El Segundo, Calif. Inertial and Digital Dept.
STATE OF THE ART OF INTEGRATED CIRCUITS
J. R. Buyan 10 Sep. 1964 31 p
(Contract AF 04(695)-469)
(TOR-469(5540-10)-1; AD-447343)

Integrated circuits are distinguished from thin-film and hybrid circuits. Current and probable future failure rates, performance, and physical characteristics are described. Yield and its relation to cost are discussed, as are other manufacturing and application considerations. High reliability, smaller size, and the ultimate low cost of high volume production are expected. Because of these factors the use of integrated circuits rather than thin-film circuits is predicted for all cases except the few for which they inherently lack the necessary performance. Author

N65-22881# RAND Corp., Santa Monica, Calif.
DYNAMIC PROGRAMMING, GENERALIZED STATES, AND SWITCHING SYSTEMS
Richard Bellman Feb. 1965 12 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4474-PR; AD-611305)

In this paper, an alternative formulation is presented in dynamic programing terms which is independent of the dimension of X, the state vector. It is based upon an extension of the concept of state variable and has application to a number of systems with switching characteristics. In its simplest form, the approach was used in the study of adaptive control processes. TAB

N65-23046# Aerospace Corp., San Bernardino, Calif.
RESPONSE OF A SECOND-ORDER LINEAR SYSTEM TO A TIME-SYMMETRICAL INPUT
J. S. Avrin Mar. 1965 15 p
(Contract AF 04(695)-469)
(TDR-469(55810-74)-1; BSD-TR-65-233; AD-460770)

The response of a familiar dynamic system to a particular, time-symmetrical waveform is derived and expressed in terms of system parameters, effective input pulse width, and a certain tabulated function. This type of problem arises notably as a result of crossing or passing phenomena. However, in contrast to the abundance which prevails in the case of inputs limited to positive time, closed form solutions for the time-symmetrical case are generally not readily available; each problem must be treated individually. Approximation methods, which are usually invoked, are generally applicable only to the extremes of input behavior. Availability of the solution presented permits continuous variation of input behavior through the region of transition from good system following to poor following and, finally, to impulsive response. Requirements for the appearance of "marginal impulsive response are also examined and help provide insight into the parameter requirements which qualify a waveform as an impulse. Author

N65-23107# General Precision, Inc., Little Falls, N. J.
GYROFLEX FREE GYRO CAPTURE LOOP COMPENSATION
R. Stomber 18 Jan. 1965 10 p
(Rept.-1-2252-40)

The purpose of this investigation is to determine the compensation networks and electronic gain necessary to stabilize the Gyroflex Free Gyro gimbals when the torquer from the Kearfott Acceleration Integrating Gyroscope (KAIG) is used. Results indicate that the outer gimbal servo loop of the Gyroflex Free Gyro can be stabilized with the LCI (Low Cost Inertial Platform) azimuth gimbal compensation network, since the electronic gain is different from the LCI electronics. The transfer function of the outer gimbal electronics is given. The given transfer function of the electronics for the inner gimbal servo loop is also not identical to the LCI network. The synchro alinement loop is stabilized using the compensation network

$$N(S) = \frac{\frac{S}{(50+1)}}{\frac{S}{(1000+1)}}$$

Author

N65-23255*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF LINEAR-INDUCTION OR TRAVELING-WAVE ELECTROMAGNETIC PUMP OF ANNULAR DESIGN
Richard E. Schwirian Washington, NASA, May 1965 36 p refs
(NASA-TN-D-2816) CFSTI: HC $2.00/MF $0.50

Method of analysis is the solution of Maxwell's equations, in the form of the magnetic equation, in cylindrical coordinates for the axial and radial components of the magnetic flux density. Effects of fluid and duct-wall conductivity on distribution and magnitude of the magnetic field are included, as are two-dimensional effects. General solutions are specialized by applying the appropriate magnetic boundary conditions at each fluid-duct-wall, duct-wall-core, and core-space interface. Excitation currents in the coils are approximated by an equivalent surface current density at the interface between the outer core and the duct wall for consistency with the method of analysis. The concept of multiple passages in a single pumping unit as compared with multiple pumps for use in parallel radiator coolant loops is proposed. An optimization procedure based on maximizing efficiency for a fixed peak coil current density over the full range of slip and a range of fluid velocities and pump radial dimensions is outlined. A single-passage 40-pound-per-second pump was designed at efficiency of 21.9% with a weight of 145 pounds. A multiple-passage pump of the same capacity was designed with efficiency, 20.7% and weight, 149 pounds. A single-passage pump designed possessed efficiency, 16.4% and weight, 68 pounds (total weight of four pumps, 272 lb). Each pump, for a design pressure of 30 pounds per square inch, is a reasonable magnetic–hydraulic design for a space power system. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-22263# Air Force Systems Command, Wright-Patterson AFB. Air Force Flight Dynamics Lab.
BACKGROUND OF PILOTED SIMULATOR DEVELOPMENT
C. B. Westbrook Aug. 1964 72 p refs
(FDCC-TM-64-28; AD-457592)

A review is made of the piloted simulation facilities commonly used in the United States. An attempt is made to classify these facilities, and to understand how and why these facilities are needed and came into being, and how they are used. Some thoughts on the philosophy of use of simulation are offered, and conclusions presented. Author

N65-22451# Little (Arthur D.), Inc., Cambridge, Mass.
STUDIES OF THE PHYSICAL CHARACTERISTICS OF PROBABLE LUNAR SURFACE MATERIALS, PART II Final Report
Peter E. Glaser, ed. Nov. 1964 134 p refs
(Contract AF 19(628)-421)
(AFCRL-64-970(II); AD-613965)

This report presents theoretical and experimental studies to determine the physical properties of probable lunar surface materials in a simulated lunar environment. To accomplish these goals, the following tasks were performed: (1) installation of two ultrahigh-vacuum systems; (2) preparation of and synthesis of materials to simulate the rock compositions most likely to be present on the moon; (3) analysis and experimentation on the surface effects on adhesion; (4) analysis and experimentation on electrostatic effects; (5) studies of radiation damage; and (6) analysis and measurement of thermal properties in a high vacuum. Author

N65-22519# Watertown Arsenal Labs., Mass. Research and Development Div.
U. S. ARMY ROCKET AND MISSILE CONTAINER DESIGN GUIDE
Edward E. Nicholas, ed. and Paul L. Miglierina Jan. 1965 248 p refs
(AD-457235)

A guide designed to document the fundamentals and techniques of container technology and to insure reliability, uniformity, and economy in the logistic supply of missiles and rockets, is presented. Subject headings include *Principles of Military Container Design; Inventory of Army Missiles and Rockets and their Containers; Sources of Damage and Environmental Hazards Peculiar to Army Missile and Rocket Containers; Container Qualification Tests; Elastomeric Suspensions; Mechanical Suspension Systems; Bulk Cushioning; The Container Body; Handling Devices; Breathing and Dehumidification;* and *Fasteners and Sealing*. Other areas pertinent to protective container technology are briefly discussed as additional hazards and logistic problems of which the designer must be cognizant. These include corrosion, finishes, markings, temperature control, and electromagnetic interference shielding. S.C.W.

N65-22546*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN C-1 FAILURE EFFECT ANALYSIS FOR SA-5 AND COMPLEX 37-B
[1962] 293 p
(NASA-TM-X-56342) CFSTI: HC $6.00/MF $1.50

A Saturn C-1 vehicle/launch complex failure analysis is presented, based on component reliabilities and single-failure effects analyses. A systematic separate analysis of each component system revealed the weaknesses and the effect of the system failure on the vehicle. No attempt was made to define the frequency of occurrence of the failure mode of each component. Considered are *S-I Stage, S-IV Stage, Instrument Unit, Payload Assembly,* and *Launch Complex*. G.G.

N65-22547*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN C-1 ENVIRONMENTAL CRITERIA (BLOCK II AND SUBS.)
9 Mar. 1962 47 p refs
(NASA-TM-X-56341; IN-M-P&VE-V-62-1) CFSTI: HC $2.00/MF $0.50

This document presents the natural and the induced environments be expected during manufacture, test, storage, transportation, launch and flight of the Saturn C-1 vehicles beginning with SA-5. The natural and the induced environments are also presented for launch complex 37 and complex 34. Author

N65-22680# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

ELECTRON CYCLOTRON RESONANCE PLASMA ACCELERATOR Final Technical Report, 1 Jan.–31 Dec. 1964

H. Hendel and T. Faith 31 Jan. 1965 34 p refs

(Contract AF 49(638)-1342)

(AED-R-2640; AD-612175)

Results are presented for a continuously operating electron cyclotron resonance plasma accelerator at a frequency of 2.45 kMc and absorbed power levels of up to 0.5 kW. Langmuir probe measurements indicate that a space charge field set up by energetic electrons (electron temperature approximately 15 eV) accelerates plasma ions to energies of from 35 to 150 eV, as measured by a retarding-field ion-energy analyzer. Langmuir probe plasma potential measurements were made adjacent to the analyzer and the effects of ion acceleration in the plasma beam-analyzer sheath were subtracted from the ion energy measurements. The final ion energy shows a linear relationship to the electron temperature in agreement with the theory. Strong electron confinement along magnetic field lines was observed in the discharge region. At low power approximately 30% of the absorbed microwave power is converted into kinetic energy of the ions. At a power of 0.5 kW, due apparently to strong excitation in the magnetic bottle region, electrons from this region are connected by the magnetic field lines to the waveguide walls and losses for bottle configurations of the magnetic field were found to be high (efficiency of 4%). Author

N65-22756 Army Engineer Waterways Experiment Station, Vicksburg, Miss.

LABORATORY INVESTIGATION OF THE MOBILITY OF PNEUMATIC TIRES IN COHESIONLESS SOIL

D. R. Freitag and C. J. Powell *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 333–347 (See N65-22732 12-34)

Some special tests show that the single-wheel data can be related readily to the performance of an actual 4×4 vehicle. The results of these tests show that a tire's performance varies in a regular and systematic way in response to the three primary independent variables of soil strength, tire load, and tire deflection. In a particular test condition, the amount that a tire sinks and slips is related to the other test variables. However, except in a very general sense, it was not possible to correlate the performance data for all tire sizes and shapes by means of single general expression. Author

N65-22787 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

A NEW TEMPERATURE-ALTITUDE ENVIRONMENTAL CHAMBER

R. Wlochowicz *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 27–31 From Bull. of Radio and Elec. Eng. Div., v. 12, no. 3, Oct. 1962 (See N65-22781 12-31)

The environmental test chamber selected for tests in connection with the upper atmosphere rocket sounding program is described. The chamber itself is double walled; the inner chamber, made of a light stainless steel with a low thermal capacity, is separated from the outer pressure vessel by 23 cm of inorganic insulation. A large door and four ports provide access to the ~1-m^3 work area within the inner chamber. The vacuum system consists of a rotary mechanical roughing pump, a small diffusion pump, and a forepump which are used to provide high and low altitude operation modes. Pressure monitoring, recording, and controlling instruments are described as well as a safety device to prevent buildup of a pressure differential between the inner and outer chamber walls. A cascade mechanical refrigeration unit, 9-kW heaters, an air circulator, and a strip chart recorder–controller–programer are the major components of the temperature system. Temperatures ranging from −75° to +260° C are attainable, and the maximum altitude simulated is 110 cm (5 × 10^{-5} mm Hg). M.P.G.

N65-22790 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

A CONTROL CONSOLE FOR CHECK-OUT OF SOUNDING ROCKETS

D. H. O'Hara and A. K. Scrivens *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 43–48 From Bull. of Radio and Elec. Eng. Div., v. 13, no. 3, Sep. 1963 (See N65-22781 12-31)

The control console developed for use with an umbilical cable to check out instrumentation contained in the nose cones of sounding rockets is described. Because of the variety of rocket experiments that are launched over a short period of time, prewired program boards similar to those used for computers are inserted in the control console so that each switch relay or pilot light in the console is connected to a terminal in the program board. Additional lamp display equipment is available to check the wiring of the console quickly and accurately whenever the need to locate and correct errors arises. M.P.G.

N65-22827# Aeronutronic, Newport Beach, Calif.

ASTRODYNAMIC RESEARCH AND COMPUTER PROGRAMS Final Report

Jan. 1965 37 p

(Contract AF 19(628)-3393)

(ESD-TDR-65-170; AD-612156)

The areas of liaison and direct support, on-site data processing, and Spadats (space detection and tracking system) control center data processing are reported. TAB

N65-22847*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MINUTES OF THE VEHICLE MECHANICAL DESIGN INTEGRATION WORKING GROUP MEETING NO. 6, S-IVB STAGE (SATURN IB/V)

Roland F. Griner 14 Oct. 1964 434 p Meeting held at Huntington Beach, Calif., 26–27 Aug. 1964

(NASA-TM-X-56359) CFSTI: HC $7.34/MF $2.25

The minutes of the vehicle mechanical design integration working group meeting contains information on: *Stage Weight Status (Saturn IB/V); Structural Qualification Testing (Saturn IB/V); Structural Design Loads and Strength Analysis; Battleship; Continuous Venting (Saturn V); Auxiliary Propulsion System; Propellant Tank Design and Pressurization; Propulsion System Performance; Propulsion Miscellaneous (Saturn IB/V); Environmental Control (Saturn IB/V); Thermal Engineering; Leak Detection; Hydraulic System (Saturn IB/V); Hydrostatic Stage; Dynamics Stage (Saturn IB and V); Facilities Checkout Stage (S-IVB-F); Interstage Venting; Interface Control; Configuration List (Saturn IB/V); Solid Ullage Rockets; Ground Support Equipment;* and *Major Problem Areas* on a cryogenic auxiliary propulsion system. G.G.

N65-22862*# National Aeronautics and Space Administration, Washington, D. C.

[ROLE OF UNIVERSITIES IN THE SPACE PROGRAM] News Release

James E. Webb 1 May 1965 13 p Address presented at the Rose Polytech. Inst., Terre Haute, Ind. Available from the Scientific and Technical Information Division

James E. Webb, Administrator, National Aeronautics and Space Administration, discusses the importance of the space agency's participation in the nation's efforts to strengthen its educational institutions. It is pointed out that the success of the national space program depends to a very large degree on the quality and the extent of involvement by universities. G.G.

N65-22863*# National Aeronautics and Space Administration, Washington, D. C.

ASTRONAUTS NEWS CONFERENCE: CREW AND BACK-UP PILOTS FOR GEMINI 4 MISSION News Release

James A. Mc Divitt, Edward H. White, II, Frank Borman, James A. Lovell, Jr., George E. Mueller et al 29 Apr. 1965 37 p Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration presents the minutes of a news conference with the crew and backup pilots for the Gemini 4 mission. The flight procedure and experiments for the upcoming flight are discussed, and the possibility of an astronaut partially emerging from the hatch during space flight is considered. G.G.

N65-23045# Army Dept., Washington, D. C. Office of the Chief of Engineers

DRAINAGE AND EROSION-CONTROL STRUCTURES FOR AIRFIELDS AND HELIPORTS Engineering and Design Manual

(EM-1110-345-283)

This manual provides design criteria for the more common drainage and erosion control structures for airfields and heliports and cover requirements for various types of pipe for varying wheel loads and for protection of storm drains against freezing conditions in seasonal frost areas. Author

N65-23068*# Chrysler Corp., New Orleans, La. Engineering Dept.

SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME III: LH_2 FUEL SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS AND MECHANICAL SCHEMATICS

Aug. 1964 62 p

(Contract NAS8-4016)

(NASA-CR-62490; SDES-64-415, Vol. III) CFSTI: HC $3.00/MF $0.75

The liquid hydrogen fuel system comprising the equipment on launch complex 37B, and the launch vehicle equipment within the S-IV stage are described. This system stores LH_2 for fueling the S-IV stage, it transfers LH_2 to and from the S-IV stage, and it controls the supply of LH_2 to the S-IV stage propulsion system. The major components and subsystems are discussed and the operation of the system during an abort-free vehicle countdown, launch, and flight is evaluated without consideration of abortive malfunction or exclusive systems for maintenance of the launch complex equipment. Alphameric listings of LH_2 fuel system components that function during the prelaunch countdown, during vehicle flight, or in the event of a launch cancellation are included. G.G.

N65-23069*# Chrysler Corp., New Orleans, La. Engineering Dept.

SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME VI: ENVIRONMENTAL CONDITIONING SYSTEMS FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS

May 1964 56 p

(Contract NAS8-4016)

(NASA-CR-62489; SDES-64-414, Vol. VI) CFSTI: HC $3.00/MF $0.50

Three launch complex 37B environmental conditioning systems which regulate the atmospheric environment of the SA-8 vehicle prior to launch are environmental control system (ECS), GN_2 deluge purge system, and water quench system. System components are in launch control center (LCC), automatic ground control station (AGCS), umbilical tower, and launcher area. The ECS receives GN_2 from the nitrogen storage battery and ambient air from a remote air intake. Three conditioning units, each with the capability of conditioning air or GN_2, distribute the selected medium to a vehicle or launcher compartment. The cooled medium is reheated by a control unit to the specific temperature to be maintained in the compartment. The GN_2 deluge purge system provides a low temperature, inert environment in the S-I stage engine compartment in the event of an aborted launch. The GN_2 for the deluge purge system is supplied from the pneumatic control distributor in the AGCS and flows through a launcher plumbing network and a distribution manifold in the S-I stage boattail. The GN_2 deluge purge is controlled from the LCC. The water quench system supplies water to the S-I stage engine compartment in the event of a fire within the compartment. Water, supplied from a remote water storage facility, flows through the same network as the GN_2 deluge purge. Control of the water quench is from a manual pushbutton in the LCC. Author

N65-23070*# Chrysler Corp., New Orleans, La. Engineering Dept.

SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME VII: LAUNCH PAD ACCESSORIES FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS

Jul. 1964 43 p

(Contract NAS8-4016)

(NASA-CR-62488; SDES-64-415, Vol. VII) CFSTI: HC $2.00/MF $0.50

The launch pad accessories group consists of three umbilical swing arms, two propellant masts, two short cable masts, and eight holddown arm assemblies. This group attaches the vehicle to the launcher and provides the necessary connections between the vehicle and the launch complex for propellant transfer, environmental conditioning, and pneumatic and electrical services required prior to liftoff. The swing arms carry service lines to the S-I stage, the S-IV stage, and the vehicle instrument unit. Swing arm No. 1 is connected to the forward area of the S-I stage, No. 2 to the aft area of the S-IV stage, and No. 3 to the vehicle instrument unit. The tail area of the S-I stage is serviced by short cable masts No. 2 and No. 4, and by the LOX and fuel masts. The holddown arms, one at each of the eight fins, support the vehicle on the launcher and restrain the vehicle during engine ignition and thrust buildup. At launch commit time, the holddown arms release the vehicle while the swing arms and masts release and swing clear of the vehicle liftoff drift pattern. Each launch pad accessory is described. The operation of each launch pad accessory includes those operations performed to prepare the accessory for vehicle launch as well as the operation at launch commit. Author

N65-23113*# Chrysler Corp., New Orleans, La. Space Div.

SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME II: LOX SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS

Aug. 1964 65 p
(Contract NAS8-4016)
(NASA-CR-62494; SDES-64-415) CFSTI: HC $3.00/MF $0.75

The launch complex equipment for supplying LOX to the S-I and S-IV stages, and the launch vehicle equipment that stores LOX and supplies it to the S-I and S-IV stage propulsion systems during vehicle flight are discussed. A functional description for an abort-free countdown, launch, and vehicle flight is given under the assumption that both the launch complex and the launch vehicle are in a state of readiness for the prelaunch countdown. Alpha-numerical listings of the LOX system components that function during a prelaunch countdown, during vehicle flight, or in the event of a launch cancellation are given, and finding numbers identify components on schematic. Excluded are one-shot safety devices, and subsystems or components used for maintenance of the launch complex. G.G.

N65-23114*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME V: PNEUMATIC DISTRIBUTION SYSTEM, FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
May 1964 107 p ref
(Contract NAS8-4016)
(NASA-CR-62501; SDES-64-414) CFSTI: HC $4.00/MF $0.75

The subsystems and components that constitute the pneumatic distribution system of launch vehicle SA-8 and launch complex 37B are discussed. The operation and function of each major equipment for the distribution of helium and gaseous nitrogen to components, systems, and subsystems of the launch complex and vehicle-on-board storage systems is described in detail. Mechanical schematics and numerical listings of all pneumatic distribution system components that function during prelaunch countdown, vehicle flight, or in the event of a launch abort are included. G.G.

N65-23115*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME V: PNEUMATIC DISTRIBUTION SYSTEM, FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Aug. 1964 97 p ref
(Contract NAS8-4016)
(NASA-CR-62496; SDES-64-415) CFSTI: HC $3.00/MF $0.75

The pneumatic distribution system for the supply of helium and gaseous nitrogen to components, systems, and subsystems of the launch complex and vehicle onboard storage systems is discussed in detail for each major component of the system. The system receives gaseous nitrogen and helium from the storage facility and distributes these gases to the S-I stage, the S-IV stage, and the instrument unit of launch vehicle SA-10. Mechanical schematics and numerical listings of the identified components are included. G.G.

N65-23116*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I, LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOL. VI: ENVIRONMENTAL CONDITIONING SYSTEMS, FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Aug. 1964 57 p ref
(Contract NAS8-4016)
(NASA-CR-62493; SDES-64-415) CFSTI: HC $3.00/MF $0.50

Environmental conditioning systems on launch complex 37B regulate the atmospheric environment of the SA-10 vehicle and launcher area prior to launch. There are three systems, each with a different function. These systems are the environmental control system (ECS), the GN_2 deluge purge system, and the water quench system. Components of the systems are located in launch control center (LCC), automatic ground control station (AGCS), umbilical tower, and launcher area. The ECS receives gaseous nitrogen (GN_2) from the nitrogen storage facility and ambient air from a remote air intake. The ECS conditions and distributes the selected medium to the various vehicle compartments and launcher areas. The GN_2 deluge purge system provides a low-temperature, inert environment in the S-I stage engine compartment in the event of a launch cancellation. The water quench system supplies water to the S-I stage engine compartment in the event of a fire within the compartment. Author

N65-23117*# Chrysler Corp., New Orleans, La. Engineering Dept.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME VII: LAUNCH PAD ACCESSORIES—FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
May 1964 44 p
(Contract NAS8-4016)
(NASA-CR-62492; SDES-64-414) CFSTI: HC $2.00/MF $0.50

The launch pad accessory group consists of three umbilical swing arms, two propellant masts, two short cable masts, and eight holddown arm assemblies. This group attaches the vehicle to the launcher and provides the necessary connections between the vehicle and the launch complex for propellant transfer, environmental conditioning, and pneumatic and electrical services required prior to liftoff. The swing arms carry service lines to the S-I stage, the S-IV stage, and the vehicle instrument unit. Swing arm No. 1 connects to the forward area of the S-I stage, No. 2 to the aft area of the S-IV stage, and No. 3 to the vehicle instrument unit. The tail area of the S-I stage is serviced by short cable masts No. 2 and No. 4, and by the LOX and fuel filling masts. The holddown arms, one at each of the eight fins, support the vehicle on the launcher and restrain the vehicle during engine ignition and thrust buildup. At launch commit time, the holddown arms release the vehicle while the swing arms and masts release and swing clear of the vehicle liftoff drift pattern. Schematic diagrams of the system supplement the functional description. Author

N65-23118*# Chrysler Corp., New Orleans, La. Engineering Dept.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME X: SEPARATION AND FLIGHT TERMINATION SYSTEMS FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Aug. 1964 22 p
(Contract NAS8-4016)
(NASA-CR-62495; SDES-64-415, Vol. X) CFSTI: HC $1.00/MF $0.50

Discussed is the inflight separation of the S-IV stage from the S-I stage at approximately 149.2 seconds after liftoff; however, the precise time is dependent on S-I stage propellant depletion. The flight termination includes shutdown of the S-I stage engines and dispersion of propellant in both the S-I stage and the S-IV stage. Launch vehicle flight can be terminated any time after liftoff through the use of explosives that

rupture the propellant tanks. Indices contain system mechanical schematics and numerical listings of the identified components. G.G.

N65-23183*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME I: RP-1 FUEL SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
15 Apr. 1964 43 p
(Contract NAS8-4016)
(NASA-CR-62517; SDES-64-414, Vol. I) CFSTI: HC $2.00/MF $0.50

The RP-1 fuel system supplies fuel to the S-I stage propulsion system. A physical and functional block diagram of the system is provided. Portions of the system are within the S-I stage, and the remainder in launch complex 37B. The ground complex portion consists of a fuel storage facility, a fuel transfer subsystem, and equipment for controlling and monitoring the operation of system components. The vehicle portion consists of four fuel tanks, sensing elements for determining fuel level, density, temperature, and pressure, and control networks for controlling fuel tank pressurization and fuel transfer to and from the ground-based portion of the system. Physical and functional descriptions of the system components are given, and the system operation is described. An alpha-numerical listing by finding number of all components in the functional system and functional schematics of the system are given.
Author

N65-23184*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME I: RP-1 FUEL SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Jul. 1964 52 p
(Contract NAS8-4016)
(NASA-CR-62524; SDES-64-415, Vol. I) CFSTI: HC $3.00/MF $0.50

The Saturn I launch vehicle SA-10 and launch complex 37B RP-1 fuel system include launch complex equipment involved in the prelaunch fueling of the S-I stage, and S-I stage equipment that stores and pressurizes fuel received from the launch complex and controls fuel supply to the S-I stage propulsion system during S-I stage flight. Specifically excluded from this report's description are one-shot safety devices, and subsystems or components exclusively for maintenance of launch complex equipment. System equipment is identified with respect to both location and functional subsystem arrangement. The system and system functions are described in terms of an abort-free prelaunch countdown, vehicle launch, and S-I stage flight and the launch complex and the launch vehicle are assumed in a state of readiness for prelaunch countdown.
Author

N65-23185*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME II: LOX SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Apr. 1964 84 p
(Contract NAS8-4016)
(NASA-CR-62523; SDES-64-414, Vol. II) CFSTI: HC $3.00/MF $0.75

The LOX system supplies LOX to the S-I stage and S-IV stage propulsion systems. A physical and functional block diagram of the system is provided. Portions of the system are located in the S-I stage, the S-IV stage, and on launch complex 37. The launch complex portion of the system consists of a LOX storage facility, a LOX transfer subsystem, and equipment for controlling and monitoring the operation of LOX system components. Schematic diagrams provided show the arrangement of components within the system and supplement the description of it. The index of finding numbers further supplements the functional description by giving physical descriptions of components shown on system schematic diagrams.
Author

N65-23186*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME III: LH_2 FUEL SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
May 1964 68 p
(Contract NAS8-4016)
(NASA-CR-62528; SDES-64-414, Vol. III) CFSTI: HC $3.00/MF $0.75

The subsystems and components within launch vehicle SA-8 and on launch complex 37B that make up the LH_2 fuel system are described. The LH_2 fuel system supplies fuel to the S-IV stage propulsion system. Launch complex portions of the system include an LH_2 fuel storage facility, transfer line control equipment, and equipment for controlling and monitoring fuel system operations. The S-IV stage portion of the system consists of a propellant tank; sensing elements for determining system pressures, temperatures, and LH_2 container levels; and other components for controlling system pressurization and LH_2 transfer between the launch complex and the S-IV stage. A numerical index provides physical and functional descriptions of components identified in the mechanical schematics. G.G.

N65-23187*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEM DESCRIPTION. VOLUME IV: NITROGEN AND HELIUM STORAGE FACILITY FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Apr. 1964 94 p
(Contract NAS8-4016)
(NASA-CR-62516; SDES-64-414, Vol. IV) CFSTI: HC $3.00/MF $0.75

The subsystems and components of launch vehicle SA-8 and launch complex 37B that make up the nitrogen and helium storage facility are described. The LN_2 at 65 psig is routed from the LN_2 storage tank to the low-pressure vaporizer. The 50-psig GN_2 output from the vaporizer is delivered to the ECS to provide a conditioned environment in the launch vehicle, and the helium system supplies the pneumatic control distributor with gaseous helium at 6000 psig. Alpha-numerical listings of the nitrogen and helium storage facility components that function in the course of a normal countdown, and some mechanical schematics are included. G.G.

N65-23188*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME IV: NITROGEN AND HELIUM STORAGE FACILITY FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS

Jul. 1964 43 p
(Contract NAS8-4016)
(NASA-CR-62525; SDES-64-415, Vol. IV) CFSTI: HC $2.00/MF $0.50

The nitrogen and helium storage facility for gaseous nitrogen and gaseous helium used in launch complex 37B and the SA-10 launch vehicle is discussed. The nitrogen system consists of a storage tank, four LN_2 converters, four high-pressure vaporizers, a low-pressure vaporizer, two filter networks, and a GN_2 storage battery. The helium system supplies the pneumatic control distributor with gaseous helium at 6000 psig and consists of three compressors, a purifier–regulator system, and helium storage battery. System mechanical schematics and numerical listings of the identified components are included. G.G.

N65-23189*# Chrysler Corp., Huntsville, Ala. Engineering Communications Dept.
SA-9 VEHICLE AND LAUNCH COMPLEX, FUNCTIONAL DESCRIPTION. LAUNCH PAD ACCESSORIES, VOLUME VII
Apr. 1964 42 p
(Contract NAS8-4016)
(NASA-CR-62514; HEC-DO42, Vol. VII) CFSTI: HC $2.00/MF $0.50

A functional description of the mechanical and electromechanical components that are active during launch operations of Saturn I, SA-9 space vehicle and Launch Complex 37, is presented. Described are the umbilical tower swing arms, short cable masts, fuel and LOX masts, and holddown arms. Launch pad accessories for the payload (Apollo spacecraft) and maintenance and checkout procedures are excluded. Mechanical schematics and a list of applicable finding numbers are included. S.C.W.

N65-23190*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME X: SEPARATION AND FLIGHT TERMINATION SYSTEMS FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS AND MECHANICAL SCHEMATICS
Apr. 1964 17 p
(Contract NAS8-4016)
(NASA-CR-62526; SDES-64-414, Vol. X) CFSTI: HC $1.00/MF $0.50

A functional description of the separation and flight termination sequences of launch vehicle SA-8 and launch complex 37B and a description of the major components of both systems are presented. Data are presented in three sections: functional description, index of finding numbers, and mechanical schematics. Major components of the separation system include vent panels, separation bolts with frangible nuts, ullage rockets, and retrorockets. Major components of the flight termination system include command transmitter, receiving antennas, command receiver, command controller, EBW firing unit, EBW detonator, safety and arming device, and primacord and shaped charges. An alpha-numerical list of the separation and flight termination systems components is included in the index of finding numbers. Additional columns provide information on component description and function, part number, and the supplier's name and part number. The section on mechanical schematics contains diagrams which reflect all of the components involved in the functional operation of the separation and flight termination systems. S.C.W.

N65-23191*# Chrysler Corp., New Orleans, La.
SATURN I, LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. SUPPLEMENT: LEGEND AND COMPOSITE SCHEMATIC
Sep. 1964 84 p With drawing
(Contract NAS8-4016)
(NASA-CR-62491; SDES-64-414) CFSTI: HC $3.00/MF $0.75

This supplement contains a composite launch complex and vehicle mechanical schematic and an illustrated list of symbols used, in this and the preceding 10 volumes, to describe mechanical and electromechanical systems of the Saturn I, SA-8 launch vehicle, and launch complex 37B. An index contains more detailed descriptions of the components of this schematic. G.G.

N65-23208*# Chrysler Corp., New Orleans, La. Space Div.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME XI: LEGEND AND COMPOSITE SCHEMATIC
Sep. 1964 67 p
(Contract NAS8-4016)
(NASA-CR-62513; SDES-64-415, Vol. XI) CFSTI: HC $3.00/MF $0.75

Included in this volume is a combined launch complex and vehicle mechanical schematic and an illustrated list of symbols used on this schematic and on the schematics appearing in volumes I through X. Also included is an index of finding numbers. The finding numbers appearing on the composite schematic correspond to those appearing in volumes I through X. S.C.W.

N65-23226*# National Aeronautics and Space Administration, Washington, D.C.
[REVIEW OF SPACE PROGRAM SINCE 1958] News Release
James E. Webb 13 May 1965 14 p Presented at Chamber of Commerce Luncheon, Sandusky, Ohio, 13 May 1965 Available from the Scientific and Technical Information Division

James E. Webb, National Aeronautics and Space Administration, reviews the Nation's space program over the last 8 years and discusses the requirements of possible future missions. The research programs at NASA's various centers range from fundamental research in materials, chemistry, and mathematics at one end of the spectrum, to hardware development in propulsion, power sources, structures, and flight dynamics at the other end. The need of an educational program to train people with the proper knowledge and ability to carry the future programs forward is pointed out. G.G.

N65-23232# Midwestern Universities Research Association, Madison, Wis.
A LOW FIELD SUPERCONDUCTING FFAG MODEL MAGNET
G. del Castillo 26 Feb. 1965 36 p refs Sponsored by AEC through Argonne Natl. Lab.
(MURA-709) CFSTI: $2.00

The possibility of using superconducting surfaces for shaping a magnetic field to have the required H vs r dependence in a magnet of the type used in a radial sector FFAG accelerator is demonstrated for fields below 2 kG. The theoretical results of using superconducting surfaces were confirmed first by using an audiofrequency analog model where the electric skin effect plays the role of the Meissner effect for the superconductor. A study made on different coil-plate geometries indicated that it is possible to obtain exponential fields of the type $H = H_o \exp K/r_o \cdot x$. The results obtained

with an actual superconductor agree with those of the audiofrequency analog, thus proving that, up to a 2-kG field, (a) it is possible to shape the magnetic field by superconducting surfaces, and (b) modeling studies can be made using an audiofrequency analog. Author

N65-23253*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE ENVIRONMENT FACILITY FOR ELECTRIC PROPULSION SYSTEMS RESEARCH
Robert C. Finke, Arthur D. Holmes, and Thomas A. Keller Washington, NASA, May 1965 39 p refs
(NASA-TN-D-2774) CFSTI: HC $2.00/MF $0.50

A facility containing 15- and 25-ft-diameter space-environment tanks and support equipment is described. The facility is designed for testing ion and plasma thrustors, spacecraft, and related components at pressures in the 10^{-7} torr range. Total pumping capacity in the 10^{-5} torr range for air was measured at 250 000 liters per second and for hydrogen at 660 000 liters per second. The pumping systems and 28 000-square-ft liquid-nitrogen-cooled condenser are described. Data are presented on an auxiliary fast pumpdown tank that simulates ambient pressures encountered during a booster launch to 10^{-6} torr range in approximately 2 minutes. Pertinent information concerning a spin test apparatus and thrustor installation method is also included. An electrical and instrumentation system is described consisting of 2 MW of 20-kV direct-current power, a 2000-cable patch board network, a 600-channel thermocouple system, and a 400-channel digital data recorder. An annunciator system is provided to indicate status of operating equipment. Some aspects of safety are considered, including interlocking, personnel protection, and procedures. Author

N65-23254*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIMULATOR STUDY OF PILOT-CONTROLLED LUNAR TAKE-OFF AND RENDEZVOUS
Charles P. Llewellyn Washington, NASA, May 1965 41 p refs
(NASA-TN-D-2778) CFSTI: HC $2.00/MF $0.50

A three-degree-of-freedom, fixed-base simulation study of pilot-controlled lunar trajectories from lift-off through rendezvous with a space station orbiting at a 100-nautical-mile altitude has been made. The results of this planar study show that a pilot can visually determine his launch time and manually control both vehicle attitude and main-engine cutoff to arrive at the altitude and position to initiate and complete a rendezvous maneuver. It has also been shown through the use of three trajectories having coast angles of 24°, 90°, and 180° that a launch window of about 4 minutes is available. An early launch capability extended the launch window to about 5 minutes and alleviated some of the launch on-time problems. Author

N65-23261# Battelle-Northwest, Richland, Wash. Reactor and Materials Technology Dept.
IRRADIATED TUBE TESTING FACILITY
P. M. Jackson Nov. 1964 21 p refs
(Contract AT(45-1)-1830)
(BNWL-6) CFSTI: $2.00

A logical sequence for evaluating the mechanical properties of N-Reactor pressure tubing in the as-received condition is similar to evaluation after reactor service. Difficulties associated with testing a heavy tube to failure with 300° C water are compounded after reactor service by the high gamma radioactivity of the discharged tubes. Success in testing of discharged reactor pressure tubing in a pilot underwater facility led to the construction of a deep, water-filled basin 15 ft long by 10 ft wide, with six test chambers within the basin. These chambers, stainless steel bell jars, enclosed the specimen, blast shielding, and electric furnace. The vessels exclude water from the hot specimen and furnace during testing and contain the pressure surge that occurs when the hot pressurized water flashes to steam upon failure of the test specimen. Remote handling tools were developed to measure the tubes, attach end closures, attach thermocouples, and load the specimen within the furnace containment vessels. Author

N65-23281*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-31, VOLUME IV FOR THE PERIOD DECEMBER 1, 1964 TO JANUARY 31, 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
W. H. Pickering 28 Feb. 1965 392 p refs
(Contract NAS7-100)
(NASA-CR-62607; JPL-SPS-37-31, Vol. IV) CFSTI: HC $7.00/MF $2.00

Reports from the systems, project engineering, guidance and control, engineering mechanics, engineering facilities, propulsion, space sciences, and telecommunications divisions are summarized. Systems analysis, computer applications, and data systems are covered for the systems division. Environmental requirements—an experimental study of sterile assembly techniques—is summarized by the project engineering division. Flight computers and sequencers, spacecraft electric power, guidance and control analysis and integration, spacecraft control, and guidance and control research are the major areas of effort for the guidance and control division. Materials, applied mechanics, and lunar spacecraft development are discussed for the engineering mechanics division. Also, instrumentation and aerodynamic facilities is reported by the engineering facilities division. Polymer research, research and advanced concepts, liquid propulsion, and solid propellant engineering are propulsion division subjects. Space instruments, systems, lunar and planetary sciences, chemistry, physics, and applied science are covered for the space sciences division. Communications research, systems, radar astronomy, mathematical research, and coding theory are telecommunications subjects. E.E.B.

N65-23303# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica
DEPARTMENT OF ELECTRON MICROSCOPY—MANUAL FOR ELECTRON MICROSCOPY TECHNICIANS, I [REPARTO DI MICROSCOPIA ELETTRONICA—RICETTARIO AD USO DEI TECNICI ADDETTI ALLA MICROSCOPIA ELETTRONICA, I]
27 Nov. 1964 82 p ref In ITALIAN; ENGLISH summary
(ISS-64/43)

Most common techniques, or at least those already tried, taken from notes made by technicians of this department were gathered in this report. Instructions for using the various apparatus have also been included. This manual will be completed and brought up to date as soon as the demands of the work carried out require revisions. Author

N65-23304# Istituto Superiore Di Sanita, Rome (Italy). Lab. di Fisica
DEPARTMENT OF ELECTRON MICROSCOPY—MANUAL FOR ELECTRON MICROSCOPY TECHNICIANS, II [REPARTO DI MICROSCOPIA ELETTRONICA—RICETTARIO AD USO DEI TECNICI ADDETTI ALLA MICROSCOPIA ELETTRONICA, II]

27 Nov. 1964 65 p ref In ITALIAN; ENGLISH summary (ISS-64/44)

Most common techniques, or at least those already tried, taken from notes made by the technicians of this department were gathered together in this report. Instructions for using the various apparatus have also been included. This manual will be completed and brought up to date as soon as the demands of the work carried out require revisions. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-22218# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

LAMINAR SEPARATION IN SUPERSONIC FLOW Final Report, 1 Nov. 1963–31 Oct. 1964

J. J. Ginoux Oct. 1964 75 p refs

(Grant AF-EOAR-64-7)

(AFOSR-65-0352; AD-612407)

Detailed experimental investigations were made at Mach 2.21 of laminar flows over ramps, backward facing steps, and swept-back wings. Large spanwise variations of the heat transfer coefficient h were measured, with two different techniques, in the reattachment region of the flow over a backward facing step and were related to streamwise vortices present in the laminar boundary layer. Peaks in h much larger than the turbulent value were measured. By comparing spanwise total head and heat-transfer rate distributions, Reynolds analogy was found to apply quantitatively for reattaching flows with streamwise vortices. The effect of free-stream Reynolds number and of leading edge sweep, accuracy of machining, thickness and bevel angle on the intensity of streamwise vortices present in the boundary layer on swept back wings was investigated. Flow separation was detected at the leading edge. A regular pattern of streamwise vortices of small wavelength was observed outside of the boundary layer. Author

N65-22298 Watervliet Arsenal, N. Y.

BOUNDARY LAYERS IN COUPLE-STRESS ELASTICITY AND STIFFENING OF THIN LAYERS IN SHEAR

M. A. Sadowsky, Y. C. Hsu, and M. A. Hussain *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 297–308 refs (See N65-22275 12-34)

The results given by classical plane strain theory are compared with results given by couple-stress theory. Before the classical and couple-stress theories diverge they establish a common ground of eight equations in nine unknowns. Since such a system is incomplete, it will require a completion, and this is where the couple-stress theory differs from classical elasticity. In the classical theory, the completion leads to a 9 × 9 system; in the couple-stress theory it leads to a 12 × 12 system. The completions are incompatible and mutually exclusive. The common ground of the two theories is described by means of a Cartesian system. Completion of the couple-stress system in classical elasticity; development of plane strain theory in classical elasticity; development of plane strain in couple-stress theory; and the boundary conditions at interface are developed. Further, the cases of the elastic semiplane in shear bonded to rigid semiplane and the stiffening of a thin layer in shear are considered. E.E.B.

N65-22326# Hydronautics, Inc., Laurel, Md.

SUPERCAVITATING PROPELLERS—MOMENTUM THEORY

Marshall P. Tulin Sep. 1964 73 p refs

(Contract Nonr-3435(00))

(TR-121-4; AD-611580)

Based entirely on momentum and other simple considerations a reasonably complete picture of the one-dimensional pressure and velocity fields associated with heavily supercavitating propellers and drag discs was constructed. It is shown that the flow is very often retarded while approaching a heavily supercavitating propeller, so that the so-called ideal efficiency of such a propeller takes on values in excess of unity. The ideal efficiency actually increases with decreasing blade cavitational efficiency; however, the net efficiency at the same time decreases. This retardation causes a reduction of thrust deduction, or even a change in its sign. Charts are provided from which the inflow speed may readily be estimated. The effects of water tunnel boundaries are discussed, particularly the phenomena of choking. Author

N65-22360*# General Dynamics/Astronautics, San Diego, Calif.

LIQUID PROPELLANT SLOSHING IN MOBILE TANKS OF ARBITRARY SHAPE

D. O. Lomen Washington, NASA, Apr. 1965 70 p refs

(Contract NAS8-11193)

(NASA-CR-222) CFSTI: HC $3.00/MF $0.75

The irrotational motion of an incompressible, inviscid liquid contained in mobile tanks of arbitrary shape is considered. Hydrodynamic equations are derived for six degrees of freedom. All quantities are written in terms of a coordinate system which moves with the tank. The pressure, forces, moments, and surface wave height are all obtained in terms of nondimensional parameters. For tanks with an axis of symmetry and three degrees of freedom, these equations are matched with corresponding equations of motion of two mechanical systems: spring-mass and pendulum. Author

N65-22367*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

BLUNT BODY SOLUTIONS FOR SPHERES AND ELLIPSOIDS IN EQUILIBRIUM GAS MIXTURES

Mamoru Inouye Washington, NASA, May 1965 35 p refs (NASA-TN-D-2780) CFSTI: HC $2.00/MF $0.50

An inverse method was used to calculate the flow field in the nose region of blunt bodies traveling at supersonic speeds in equilibrium mixtures of gases that may be present in other atmospheres. Calculations were made for air, nitrogen, carbon dioxide, argon, and a mixture composed of 50% argon, 40% nitrogen, and 10% carbon dioxide. Speeds from 10000 to 70000 ft/sec are covered for free-stream densities of 10^{-1}, 10^{-3}, and 10^{-5} times earth sea level values. Correlations are presented for the shock standoff distance, surface pressure distribution, and stagnation-point velocity gradient. Author

N65-22385# Naval Ordnance Test Station, China Lake, Calif.

THE EFFECT OF ADDITIVES ON FLUID FRICTION

J. W. Hoyt and A. G. Fabula Dec. 1964 34 p refs

(NAVWEPS-8636; NOTS-TP-3670; AD-612056)

A brief review is given of the literature on turbulent flow of high-polymer solutions. Laboratory experiments using rotating disks and turbulent pipe flow have led to generalizations as to characteristics of friction-reducing high polymers. Linear, high-molecular-weight, soluble polymers are shown to be most effective. The maximum drag reduction achievable by polymer addition appears to be a function of the Reynolds number of the flow. TAB

N65-22390# Stanford Univ., Calif. Dept. of Mathematics
ON THE GENERATION OF SHORT TWO-DIMENSIONAL SURFACE WAVES BY OSCILLATING SURFACE CYLINDERS OF ARBITRARY CROSS-SECTION
R. L. Holford 26 Mar. 1965 41 p refs
(Contract Nonr-225(74))
(TR-4; AD-612811)

A simple method is given for determining the amplitude and phase of the surface waves generated by the forced high-frequency oscillations of a cylinder of arbitrary cross section which is partially immersed, with its axis horizontal, in the free surface of an unbounded fluid. The velocity potential of the forced motion of the fluid is split into two components: the first corresponds to the limit of infinite frequency, for which surface waves are absent, and the second corresponds to the surface-wave motion induced by applying certain pressure forces over the otherwise free surface in the presence of a fixed cylinder. An approximation is then made in which the cylinder is replaced by its tangent plane along a line of intersection of the cylinder and fluid surface. The asymptotic values of the amplitude and phase of the generated waves are calculated for a variety of cross sections, and the results are found to be in agreement with those which have been obtained rigorously for the cases of a half-immersed circular cylinder and a dock. Author

N65-22401# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ISOTHERMAL FLOWS OF A CONDUCTIVE GAS IN CHANNELS
N. I. Pol'skiy and G. M. Shchegolev 25 Mar. 1965 11 p Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (USSR), v. 2, no. 1, 1964 p 53–57
(FTD-TT-64-1036/1+2; AD-613161)

Discussed is a unidimensional scheme of a stationary flow of a conductive gas in intersected fields. The corresponding system of differential equations is presented, and the numerical solution of the written out system of equations after additional fixing of closing conditions is obtained. As a monodimensional system is not applicable to the study of real flows, a consideration of the effects of an induced field, friction, and dependence of conduction upon pressure leads to the introduction of dimensionless variables and their integration. It is observed that the value for isothermal flows with constant rate also characterizes the degree of channel widening. G.G.

N65-22402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF RECORDING A GAS FLOW VELOCITY FIELD
V. M. Kalugin and L. V. Leskov 18 Mar. 1965 5 p Transl. into ENGLISH from Russian Patent no. 160916 (Appl. no. 763008/26-10), 30 Jan. 1962 1 p
(FTD-TT-64-1085/1; AD-613174)

A method of recording the field of velocities of a gas flow was devised. For the purpose of obtaining a continuous field of velocities of the flow, a cinematographic record was made of the process of the drift of the front of the afterglow of a gas excited by focused electron beam. TAB

N65-22424# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
FORCES AND MOMENTS ON AN OSCILLATING HYDROFOIL WITH AN OSCILLATING FLAP
John M. Grace and Irving G. Statler Jan. 1965 51 p refs
(Contract NObs-88342)
(CAL-BB-1798-S-1; AD-611067)

This report presents the results of a theoretical study to determine the lift, total moment and hinge-moment acting on a fully wetted, oscillating hydrofoil with an oscillating flap in two-dimensional, linearized, potential flow. The flow was assumed to be noncavitated, but no limitations were placed on the values of Froude number or depth-to-chord ratio. The solution takes full account of the surface waves caused by the hydrofoil motion. Results are presented in graphical and tabular form. Lift, total moment, and hinge moment are given as functions of reduced frequency with Froude number, depth-to-semichord ratio and hinge position as parameters. Author

N65-22435# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING HIGH AND ULTRAHIGH PRESSURES AND DEVICE FOR ITS REALIZATION
L. A. Yutkin and L. I. Gol'tsova 15 Feb. 1965 6 p Transl. into ENGLISH from Russian Patent No. 129945 (Appl. No. 605995/25), 29 Dec. 1952 3 p
(FTD-TT-64-965/1+2; AD-611420)

A method of obtaining high and ultrahigh pressures as a result of electric pulse spark discharges in a liquid, forming electrohydraulic shocks is presented. The feature of the proposed method lies in the fact that high and ultrahigh pressures in a liquid or any given mobile, plastic medium are obtained by the method of evaporation in it of current conductive elements in form of wire, band or pipe, closing the electrodes under the effect of pulse discharge, whereby the current conductive elements are bent in profile, in accordance with a given form, or it acquires the form of a conical or spherical spiral. TAB

N65-22472# Yale Univ., New Haven, Conn. Mason Lab.
EFFECTS OF SEEDING ON THE CONDENSATION OF ATMOSPHERIC MOISTURE IN NOZZLES
E. R. Buckle and A. A. Pouring Feb. 1965 16 p refs
(Contract Nonr-609(47))
(Rept.-5; AD-612606)

When smoke particles of certain inorganic compounds are added to moist air expanding at near sonic speeds in the wind tunnel, they act as heterogeneous nuclei for the condensation of water. Unlike homogeneous condensation, which commences later in the expansion and is characterized by a hump in the static pressure distribution, heterogeneous condensation is so gradual that while it occurs the static pressure values are indistinguishable from those in a dry air expansion. Nevertheless, when the initial humidity exceeds a certain level determined by the flow conditions and the smoke concentration, heterogeneous condensation becomes sufficiently rapid to affect the local humidity, and homogeneous condensation is partially suppressed. This seeding effect can be used to eliminate normal shocks resulting from homogeneous condensation. Since it requires upwards of 10^8 particles/cc, the effect is not shown by the foreign nuclei naturally present in the atmosphere. Author

N65-22499# Joint Publications Research Service, Washington, D. C.
THE CEPHALOPOD BODY AS AN AIRFOIL
G. V. Zuyev 21 Apr. 1965 8 p refs Transl. into ENGLISH from Nauchn. Dok. Vysshei Shkoly, Biol. Nauki (Moscow), no. 1, 1965 p 22–25
(JPRS-29686; TT-65-30786) CFSTI: $1.00

Lifting force was studied in several species of Cephalopods. It was found that dorsoventral body curvature, and the velocity of translational body movement influenced the magnitude of lifting force. Studies performed on a wooden squid model support these findings. S.C.W.

N65-22565*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RECENT EXPERIMENTS IN HYPERSONIC TURBULENT BOUNDARY LAYERS
Mitchel H. Bertram and Luther Neal, Jr. [1965] 48 p refs Presented at the AGARD Specialists Meeting on Recent Develop. in Boundary-Layer Res., Naples, 10–14 May 1965; sponsored by Fluid Dyn. Panel of AGARD
(NASA-TM-X-56335) CFSTI: HC $2.00/MF $0.50

Considering the numerous and often differing theories available for determining the behavior of compressible turbulent boundary layers a choice of prediction method is often determined by the available experimental data. This paper considers this problem in the light of the results of recent experiments in a number of different facilities and from flight. The data for skin friction and heat transfer are generally from sharp flat plate and pointed cone models and are available for very cold walls up to Mach numbers of approximately 9. Mach number and wall-temperature effects from these experiments are compared to the more recent prediction methods. In addition, an evaluation of the maximum heat transfer and shear stress to be encountered on smooth flat plates and cones is made. Since boundary-layer structure is an important consideration, boundary-layer velocity and temperature profiles obtained on hollow cylinders and nozzle walls are considered. Author

N65-22607*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF UNIFORM LONGITUDINAL STRAIN RATE ON WEAK HOMOGENEOUS TURBULENCE IN A COMPRESSIBLE FLOW
Robert G. Deissler Washington, NASA, May 1965 22 p refs
(NASA-TN-D-2800) CFSTI: HC $1.00/MF $0.50

Two-point correlation equations for turbulence with a uniform strain rate in one direction are constructed by starting with the compressible Navier–Stokes and continuity equations. Compressibility is retained in the mean flow, but the problem is simplified by assuming that the turbulent eddies behave incompressibly. To close the system of equations, the weak turbulence approximation is used. The equations are converted to spectral form by taking their Fourier transforms. Solutions are obtained for the turbulent velocity variances in the longitudinal and transverse directions and for the spectra of those quantities. The transverse turbulent intensity varies in a complex manner that seems to approximate experimental heat-transfer results in highly heated tubes. A transfer term associated with the mean strain rate transfers energy to either higher or lower wave numbers, depending on whether the strain rate is negative or positive. Because of this, the peaks of the energy and dissipation spectra are separated for large negative rates of strain, even though triple correlations have been neglected; however, there is still considerable overlap of the two spectra. Author

N65-22665# North American Aviation, Inc., Downey, Calif. Space Sciences Lab.
LAMINAR BOUNDARY LAYER COMPUTER PROGRAMS
J. R. Radbill 1 Mar. 1964 72 p refs
(SID-64-1039)

A computer program is described that calculates locally similar solutions for a two-dimensional compressible laminar boundary layer with heat transfer and a power function pressure gradient. Variable Prandtl number, density viscosity product, and specific heat are provided for in subroutines. Another computer program fits together the solutions calculated by the first program to approximate a general pressure gradient solution. Author

N65-22668# Emmanuel Coll., Boston, Mass. Research Language Center
MOTION OF WATER DROPLETS IN TURBULENT CLOUDS [DVIZHENIE VODIANYKH KAPEL' V TURBULENTNYKH OBLAKAKH]
S. Pancsev Bedford, Mass, AFCRL, Mar. 1964 12 p refs Transl. into ENGLISH from Idojaras (Budapest), v. 64, no. 5, 1960 p 276–280
(Contract AF 19(628)-3869)
(E-T-R-64-22; AD-611118)

The essential problem is to determine to what extent streaming water droplets are carried by turbulent pulsations. The velocity-increasing effect of the pulsations is proved numerically. This result implies that the probability for collisions is also increased. Author

N65-22679# RAND Corp., Santa Monica, Calif.
EXPANSION OF A FINITE MASS OF GAS INTO VACUUM
C. Greifinger and J. D. Cole Feb. 1965 8 p refs
(P-3067; AD-611204)

A summary is presented of research on the problem of the expansion into vacuum of a finite mass of gas initially at rest and in a uniform state, assuming a perfect and inviscid gas. The cases of plane, cylindrical, and spherical flow are considered. TAB

N65-22685# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
MOMENT METHODS FOR NON-LINEAR PROBLEMS IN KINETIC THEORY
Hilliard Kent Macomber Dec. 1964 136 p refs
(Grant NSF GP-414)
(TR-13)

The purpose of this study is to gain insight into the accuracy of a certain class of approximation procedures by applying these procedures to two model problems which may be solved exactly in numerical terms. Approximate solutions to these problems are obtained by extensions of procedures suggested by Krook. The procedures generalize the bimodal method of Mott–Smith and consist of (1) prescription of the velocity dependence of the distribution function by a linear combination of modified Maxwell distribution functions, and (2) selection of a finite number of moment equations to determine either the space-dependent parameters involved in the modified Maxwell distribution functions or, equivalently, moments related to the parameters. Comparison of the approximate and exact solutions demonstrates that moment methods can yield reasonably accurate solutions to nonlinear problems in kinetic theory. Author

N65-22994# Engineering Research Associates, Toronto (Canada).
THREE-DIMENSIONAL FREE-SURFACE EFFECTS ON HYDROFOILS
J. R. Richardson Mar. 1965 51 p refs
(Contract NObs-90084)
(ERA-53-1)

The first stage presents the development of a three-dimensional theory for thin hydrofoils. The manner in which a foil can be built up of doublets (representing thickness) and horseshoe vortexes (representing lift) is described. The first step is to find the effect of the free surface on the flow caused by doublets and vortexes. An analysis was made of a stationary source with oscillating strength. The results for pulse and step sources are obtained from the oscillating case by Fourier transforms. Finally, the pulse and step sources are integrated

along the path of motion to obtain the required moving disturbances. The boundary conditions at great distances from the disturbance are automatically satisfied when this process is used. Equations are presented for the effect of the free-surface (at any Froude number) on the supervelocities caused by a moving doublet and horseshoe vortexes oriented in vertical and lateral planes. The form of these equations was arranged so that computation is as easy as possible. Author

N65-23027# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique

MEASURING DEVICES OF SURFACE PRESSURE IN RARIFIED GAS FLOW [DISPOSITIFS DE MESURE DES PRESSIONS DE PAROI EN ECOULEMENT DE GAZ RAREFIE]

Pierre Trepaud Jan. 1965 23 p refs In FRENCH
(Rept.-65-1)

Laboratory modifications of hot wire Pirani-type gages for measuring wall or surface pressures are discussed. Modifications permitting high precision in measuring pressure ranges from microns to millimeters of mercury are described. As constructed, the gage consists of platinum wire 0.2 mm in diameter and 8 mm long placed in a double-walled cylinder having an 0.8-mm inner diameter. An isothermal fluid circulates in the space between the double walls. The wire of this gage is placed in one branch of a Wheatstone bridge; in the other branch is placed a second element having a similar hot wire placed in a vacuum sealed ampoule in the same isothermal liquid. A millivoltmeter, adjustable for maximum sensitivity, and a potentiometer are included in the circuit. The two voltages are accumulated in series with another resistance regulating the input power to the hot wire. Equilibration of pressures is thereby established in the gage, and the time necessary for establishing thermal equilibrium has no influence on the response time. The weak perturbations produced in the circuit do not influence the measurement because the sealed element has the same electrical characteristics, and the isothermal fluid prevents errors due to temperature variations. M.P.G.

N65-23042# General Applied Science Labs., Inc., Westbury, N. Y.

MEASUREMENTS OF THE TURBULENT NEAR WAKE OF A CONE AT MACH 6

A. Martellucci, H. Trucco, and A. Agnone Dec. 1964 71 p refs
(Contract ARPA SD-149; ARPA Order 396)
(GASL-TR-482; AD-456869)

Flow properties in the subsonic and supersonic regions of the turbulent near wake of a 10° half-angle circular cone at zero angle of attack in a Mach 6 flow were measured at a stagnation pressure of 800 psia with a corresponding Reynolds number of 14.4×10^6/ft. The boundary layer flow on the cone surface was turbulent for the entire test series. Several model support schemes were investigated in determining that the system providing a minimum of support interference consists of a slender axial sting attached to the model nose and also extended upstream through the nozzle throat. The model was supported at the base by three bands with a 60° sweepback. The total temperature and total and static pressure distributions in the supersonic part of the wake were recorded at various axial stations and radial distances from the model axis. The radial base pressure distribution, the locus of all points in the recirculation zone where there is only a component of velocity normal to the cone axis, the pitot and static pressures on the model axis in the subsonic region, and various properties in the recirculation zone are presented. Author

N65-23049# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEVICE FOR MEASURING TOTAL AND STATIC PRESSURES IN UNSTEADY GAS-DYNAMIC FLOWS

S. Yu. Chernyavskiy 10 Feb. 1965 5 p Transl. into ENGLISH from Soviet Patent No. 159867 (Appl. No. 779951/26-10, 26 May 1962) 2 p
(FTD-TT-64-955/1+2; AD-611547)

The object of the invention is a device for measuring the total and static pressures in unsteady gas-dynamic flows which contains pickups fastened to a forked holder in one of which at the end or face part and in the other in a lateral flow-through piezo elements are located. To increase the dependability of the device and to reduce the temperature errors in measuring in it, the piezo elements on the outer side are covered by heat-protection plates with acoustic-impedance of the piezo elements. These plates serve at the same time as electrodes of the piezo converters. TAB

N65-23056# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Berlin (West Germany). Institut für Turbulenzforschung

INTRODUCTION TO THE NONLINEAR HYDRODYNAMIC STABILITY THEORY [EINFEHRUNG IN DIE NICHTLINEARE HYDRODYNAMISCHE STABILITATS-THEORIE]

H. Schade Dec. 1964 62 p refs In GERMAN; ENGLISH summary
(DVL-379; DLR-FB-64-35) Available from ZLDI, Munich: 16 DM

Following a description of the phenomena to be explained by the hydrodynamic stability theory, the nonlinear stability theory by J. T. Stuart is treated; and its applicability is illustrated by calculating the equilibrium amplitude of two-dimensional neutral disturbances of the shear profile $u_0 = \tanh y$ for infinite Reynolds number, and comparing the result with measurements by H. Sato. Author

N65-23077# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.

CALCULATED HYDRODYNAMIC LOADS ON AN OSCILLATING HYDROFOIL

Thomas J. Langan and David W. Coder Jan. 1965 38 p refs
(DTMB-1695; AD-610797)

Formulas for the amplitude and phase angle of the two-dimensional unsteady lift and moment on an oscillating foil are derived together with formulas for the reduced lift and moment coefficients. Numerical values of the reduced force coefficients and associated phase angles are presented in graphs and tables. A sample calculation is included to demonstrate the use of the formulas and graphs. Author

N65-23102# Stanford Univ., Calif. Thermosciences Div.

CONFIGURATION AND STABILITY OF ROTATING AXISYMMETRIC MENISCUS AT LOW g

J. G. Seebold and W. C. Reynolds 1 Mar. 1965 90 p refs
(Grant NSF GP-2720)
(LG-4)

The stability and shape of the axisymmetric meniscus in a cylindrical tank rotating at constant angular velocity ω about its axis are discussed. It is assumed that the contained liquid is in a state of solid body rotation, that all properties are constant, and that the liquid is inviscid, therefore the Bond Number Bo, rotational Weber Number Ω^2, and contact angle θ suffice to completely determine both the shape and stability of the meniscus. The boundary value and eigenvalue problems are solved simultaneously as initial value problems

by computerized numerical integration. The resulting dimensionless parametric stability map tells when a stable meniscus can be expected to exist. Similar dimensionless maps are presented for the cases in which Bo, Ω^2, or Θ, are zero. The generalized results are specialized to the case of zero gravity (Bo = 0). Height of rise of the liquid up the wall, and depth of fall at the center, are presented as functions of contact angle, with the rotating Weber Number as a parameter. Rotation is found to have a marked effect on the stability and configuration of capillary systems. Nonwetting liquids tend to be stabilized by rotation, wetting liquids, destabilized. The menisci of wetting liquids in zero-g become much more extended under rotation; with sufficient rotation the meniscus undergoes a transition to a bubble or pseudo-annular shape. Experimental results described quantitatively support the analysis. Author

N65-23119*# Wyle Labs., Inc., El Segundo, Calif.
AERODYNAMIC NOISE RESEARCH SUPPORT Quarterly Progress Report, Jan.–Mar., 1965
M. V. Lowson 9 Apr. 1965 23 p refs
(Contract NAS8-11308)
(NASA-CR-62497) CFSTI: HC $1.00/MF $0.50

A classification scheme for the separated parts of the flow field which are the major sources of fluctuating pressures on space vehicles is described. The separations of a supersonic turbulent boundary layer induced by a forward facing flare or step may be described as either flare or shoulder reattachment, though the possibility of pseudo-separation is pointed out. It was found that the later stages of transition from laminar to turbulent flow in a boundary layer bear a strong resemblance to the vortex breakdown observed in separated flow over slender wings. New evidence supporting the hypothesis that the wall pressure fluctuations are the result of laminar sublayer eruption is discussed. J.M.D.

N65-23128# Army Missile Command, Huntsville, Ala. Advanced Systems Lab.
BASE PRESSURE FOR BODY OF REVOLUTION WITH EXTENDED NOZZLE
Troy A. Street 22 Jul. 1964 25 p refs
(RF-TM-64-23; AD-611159)

A program to predict base pressure for a body of revolution with a nozzle extended behind the body was developed in Fortran II for the IBM 1620. The program considers a closed wake, two-dimensional solution. Comparisons of the program results with experimental data and turbulent theory are presented graphically. Author

N65-23216# Purdue Research Foundation, Lafayette, Ind.
A STUDY OF INCOMPRESSIBLE, BOUNDED TURBULENT JETS
John F. Foss and J. B. Jones Nov. 1964 275 p refs
(Contract DA-83(D)-AMXDO-CSA-40(A))
(AD-611189)

Part of the study was directed to the establishment and investigation of three-dimensional effects of a single bounded jet flow between parallel plates. From velocity traverses taken between the bounding plates, existence of an important three-dimensional effect was observed. A physical flow model was postulated, the vortex stretching hypothesis, to explain this. Experiments were conducted to examine predictions made on the basis of the model; agreement between observed and predicted mean flow characteristics and distributions provides substantial support for the vortex stretching hypothesis. Another part of the program was an investigation of the jet interaction problem, the governing factor in all proportional fluid jet amplifier devices, and an important factor in the operation of bistable amplifier elements. The investigation of the intersecting jet problem was exploratory. Four studies were conducted with the intent of establishing information bench marks from which further information could be inferred. Author

N65-23308# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.
STEADY EXPANSIONS AT HIGH SPEED RATIO USING THE B-G-K KINETIC MODEL
John W. Brook and Richard A. Oman Oct. 1964 35 p refs
Presented at the 4th Intern. Symp. on Rarefied Gas Dyn., Toronto, Jul. 1964
(RE-183J)

Numerical calculations of axially symmetric and two dimensional steady expansions of a monatomic gas were carried out using an approximate Boltzmann equation with a Krook collision term. The calculations are performed for a variety of stagnation temperatures and sonic Reynolds numbers. At large distances from the sonic line, the velocity and density profiles follow the results predicted by inviscid flow theory, but the temperature freezes at a value dependent primarily on the sonic Reynolds number and stagnation temperature. A somewhat anomalous dependence of the final temperature on the particular initial distribution function used in the iterative procedure is also found. Transport data for argon were used in the calculations. Author

N65-23340# Lockheed Missiles and Space Co., Sunnyvale, Calif.
GASDYNAMIC INTERACTIONS INDEPENDENT DEVELOPMENT PROGRAM Summary Report
V. V. Baicher, R. J. Kraus, and H. A. Ashby Jan. 1965 72 p refs
(LMSC-TM-52-12-09)

A study to determine the fundamental nature of the gas dynamic recirculation process which gives rise to staging force, moment, and environment problems in rocket powered separations is reported. Parametric cold gas experiments were conducted for a series of progressively more complex idealized interstage configurations which would exhibit the steps in the recirculation phenomenon. The experimental program was completed and data are presented. Comparison between certain of the data and previous experimental results showed good agreement. Also, a discussion of theoretical concepts concerning interstage gas dynamics is given. Under experimental conditions where the jet boundary is very weak, the first stagnation theory shows reasonable agreement with experiment, implying that the basic equations of the theory are valid. Further, the comparisons of theory and experiment showed that the interaction of the jet boundary with the first stagnation flow field produces a thin gas layer along the floor of the interstage. E.E.B.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-22219# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN NO. 3
Anne L. Carrigan and Norman J. Oliver, ed. Jan. 1965 200 p
(AD-612083)

Presented is a bulletin containing data on continued research under the following programs: component magnetometer, cosmic-ray neutron intensity monitor, oblique H-F propagation, riometer, and solar radio emission (spectral observations). A new section on oblique backscatter radar at a frequency of 49.620 Mcps is included. Also included is the program description for the new section along with additional information for the program descriptions of the component magnetometer, cosmic ray neutron intensity monitor, and the riometer. S.C.W.

N65-22221# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.
A COMPENDIUM OF PAPERS IN THE FIELDS OF GEODESY AND PLANETARY GEOMETRY PREPARED AT AFCRL DURING 1963 Special Reports No. 18
Owen W. Williams, ed. Jan. 1965 178 p refs
(AFCRL-65-14; AD-611003)

This compendium presents a series of selected technical papers prepared by scientists of Air Force Cambridge Research Laboratories during 1963 in the fields of geodesy and planetary geometry. These papers describe research activities in the areas of satellite geodesy, airborne gravimetry, instrumentation calibration via satellite, laser geodesy, land gravity instrumentation and programs, and selenodesy (geodesy of the moon), illustrations show recent geodetic instrumentation developments and technique configurations. Author

N65-22237# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services
A NEW TYPE OF TECTONIC STRUCTURE
A. Ya. Saltykovski Sep. 1964 3 p Transl. into ENGLISH from Priroda (Moscow), v. 11, 1963 p 113–114
(T-415-R; AD-612099)

Independent structural units called epigons, or epigonals are discussed. These structures were developed after the stage of completed folding, and at some points upon areas of pre-Cambrian platform, or directly after the geosynclinal stage. Although formally epigons do possess a combination of features of geosynclinal and platform development, they are independent structures of the first order. One of the most characteristic of such structures is the West trans-Baikal Mobile Zone. Within this zone, in the lower Mesozoic, there took place an intensive magmatic activity, processes of fold formation, emplacement of a variety of intrusions. The deposits are, in the main, heterogeneous lava effusions and clastic formations of volcanic origin—normal sedimentary deposits are rare. This zone was formed in a region that had successively passed through the Baikal stage of folding (about 1000 million years ago) the Caledonian stage (600 million years ago) and Hercynian stage (about 400 million years ago). The development of epigonal regions was characterized by a slow downwarping and the accumulation of the thick volcanogenic deposits, as would be appropriate for the initial stages of geosynclinal development. TAB

N65-22257# Northwestern Univ., Evanston, Ill. Dept. of Geography
A REVIEW ON MEASURES OF CONTIGUITY FOR TWO AND k-COLOR MAPS
Michael F. Dacey Feb. 1965 41 p refs
(Contract Nonr-1228(33))
(TR-2; AD-612068)

The use of measures of contiguity as one aspect of the geographic study of an area partitioned into regions is discussed; and two typical problems illustrate application of these methods. This report emphasizes contiguity measures for two and k color maps, and is largely drawn from studies published in the late 1940's on the distribution of joins on two- and k-color lattices. A table useful for testing the hypothesis of randomness on two color maps is included; the double binomial distribution, defined by the probability function

$$[r!/x!(r-x)!]\,[p^{r-x+1}(1-p)^{x}+p^{x}(1-p)^{r-x+1}],$$

is tabulated with 5 DP for p = .01(.01).50, r = 1(1)10 and x = 0(1)r. Author

N65-22281 Army Electronics Labs., Fort Monmouth, N. J.
THE RELATION BETWEEN CLOUD CHARGES, PRECIPITATION AND LIGHTNING DISCHARGES
Heinz W. Kasemir *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 67–78 refs (See N65-22275 12-34)

A theory is developed which links together the different electric parameters of a thunderstorm such as precipitation charge, stationary electric fields, and lightning discharges. In the concept proposed, lightning starts between two charge centers where the electric field has a maximum value. The idea is that of an uncharged conducting rod exposed to an electric field. The lightning flash stops, not because the cloud charges are exhausted, but because the field strength at its tips does not exceed the breakdown value. Charge distribution in the thundercloud, the cloud discharge, the ground discharge, and the relation between properties of the electric field of a lightning discharge and thunderstorm parameters are discussed in detail. E.E.B.

N65-22283 Army Engineer Waterways Experiment Station, Vicksburg, Miss.
THE DYNAMIC STRESS–STRAIN RELATION FOR A SAND AS DEDUCED BY STUDYING ITS SHOCK WAVE PROPAGATION CHARACTERISTICS IN A LABORATORY DEVICE
T. E. Kennedy and A. J. Hendron, Jr. *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 89–103 refs (See N65-22275 12-34)

The propagation of a shock wave through various types of materials was considered, and the behavior unique to each type of material was discussed. While the theoretical relationships could not be used to predict behavior without prior knowledge of the dynamic stress–strain relation for the sand, the relationships derived were useful in deducing the dynamic stress–strain relation from the observed behavior. The data observed from a series of tests indicate that the dynamic stress–strain relation for Cook Creek sand is concave about the strain axis at lower stress levels and concave about the stress axis at higher stress levels. It appears that the point of inflection on the dynamic stress–strain curve is between 18 and 40 psi. The available data also indicate that the difference between the static and dynamic stress–strain relations becomes less significant at higher pressures. Further experiments are needed to establish in more detail the quantitative, dynamic stress–strain for Cook Creek sand, but the results of these pilot tests indicate the general shape of the curve and have yielded information which will aid in planning future sand column experiments. Author

N65-22317 Naval Research Lab., Washington, D. C. Nucleonics Div.
SURVEY FOR RADIOACTIVE CONTAMINATION IN THE VICINITY OF THE USS THRESHER

C. F. Dohne and J. I. Hoover *In its* Report of NRL Progress 1965 p 6–13 refs (See N65-22315 12-34) CFSTI: $1.25

The spectral distributions of the gamma rays from radioactive isotopes in the deep ocean and in the vicinity of the USS Thresher were measured. The measurements were conducted from the Bathyscaphe Trieste II using a sodium iodide crystal coupled to an EMI photomultiplier tube, and a 400 channel pulse height analyzer. No spectral lines, other than those associated with normal sea water or bottom sediment, were evident in the spectral data taken in the vicinity of the Thresher. It is concluded that no exchange took place between the reactor system and the sea. Author

N65-22319# Air Force Cambridge Research Labs., Bedford, Mass.

AIRGLOW CALIBRATIONS SYMPOSIUM Special Reports No. 22

G. J. Hernandez and A. L. Carrigan, ed. Dec. 1964 117 p refs Presented at the Airglow Calibrations Symp., Bedford, Mass., 17–18 Dec. 1963

(AFCRL-65-114; AD-613632)

The following calibration techniques were among those discussed at the symposium on low light level and airflow absolute calibrations. (1) A blackbody is used as the primary standard with secondary and tertiary standards constructed of tungsten lamps as light sources. For ultraviolet calibration, a tungsten lamp is used as the primary standard and a hydrogen lamp as the secondary emission source. Comparison of the brightness between standards is made at discrete wavelengths by the use of a grating spectrometer. (2) Photometers are calibrated against a tungsten ribbon filament lamp. The filament is heated by an accurately measured direct current and the color temperature of the filament is found from its calibration curve using the known value of the heating current. (3) The sun is used as an absolute standard. Also, a standardization of measurements on intensity, spectrum of the night airglow, methods of observation, calibration of airglow photometers, filter glasses for isolating some mercury line emissions, photometer calibration source, computation of source radiation, and absolute spectral distribution of a surface having color temperature 2360° K and brightness 0.1 micro-Lambert are included. E.E.B.

N65-22330# Oregon State Univ., Corvallis. Dept. of Oceanography

SEISMOLOGICAL BULLETIN NO. 4, APRIL 1–JUNE 30, 1964 Data Report No. 18

C. E. Schatz and Peter Dehlinger Jan. 1965 12 p

(Contracts AF 19(628)-2778; Nonr-1286(10))

(AD-612180) CFSTI: $1.00

Oregon State University operates a worldwide standard seismograph station at Corvallis and a seismic station at Klamath Falls, Oregon. The Corvallis station includes three short-period Benioff seismographs (T_0 = 1 sec, T_g = 0.75 sec), three long-period Sprengnether seismographs (T_0 = 30 sec, T_g = 100 sec), and a small short-period vertical Benioff seismograph (T_0 = 1.0 sec, T_g = 0.2 sec) to provide visual recording on the OSU campus. The Klamath Falls station consists of a small short-period vertical Benioff seismograph (T_0 = 1.0 sec, T_g = 0.2 sec), with visual recording on the campus of the Oregon Technical Institute. Tables are presented displaying the following data: sudden beginning of motion, gradual beginning of motion, following phase of arrival, magnitude, depth of focus, and epicentral distance from Corvallis. TAB

N65-22359*# Michigan Univ., Ann Arbor.

ATMOSPHERIC MEASUREMENTS OVER KWAJALEIN USING FALLING SPHERES

J. W. Peterson, W. H. Hansen, K. D. Mc Watters, and G. Bonfanti Washington, NASA, May 1965 57 p refs

(Contracts NASw-138; NASr-54(05); N123(61756)31925A-(PMR))

(NASA-CR-218) CFSTI: HC $3.00/MF $0.50

The results of 13 firings over a 15-month period at Kwajalein are discussed. Inflatable spheres of mass 50 grams and diameter 66 cm were deployed from Nike-Cajun rockets on the ascending part of the trajectory and tracked by the Tradex radar. Density and temperature profiles were derived from the tracking data from as low as 32 km to as high as 120 km. Horizontal wind profiles were also derived to 70 km. Measured temperatures were higher than the U.S. Standard, 1962 near 50 km and lower near 100 km. An indication of atmospheric heating was found in six of the profiles near 85 km. A day–night pair of soundings showed a relatively large increase in the daytime density that was not accompanied by a change in the temperature profile. Author

N65-22408# John Carroll Univ., Cleveland, Ohio. Seismological Observatory

ANALYSIS OF THE RELATIONSHIP BETWEEN ASSOCIATED VOLCANIC AND SEISMIC EVENTS Final Report

Edward J. Walter 31 Dec. 1964 112 p refs

(Contract AF 19(628)-218; ARPA Order 292; Proj. Vela-Uniform)

(AD-613298)

Earthquakes that occur in volcanic regions and result from volcanic processes were studied. The purpose was to determine whether or not these volcanic quakes are the same as ordinary earthquakes, and if not, just how they differ and what seismic parameters can be used to identify them. Three areas were selected for investigation: Italy, Hawaii, and Japan. Volcanoes in Italy and Japan are explosive while those in Hawaii are not. Seismic data from all three areas were analyzed. Crustal models and seismic wave velocities, where available, were used as a basis for locating epicenters. Graphical methods such as the Δ P-H Arc-Distance Method and the Hyperbolic Method were used to locate epicenters. A computer program was set up and several techniques were developed to augment the use of data in the computer program. One of these was the technique of supplying a fictitious arrival time at a seismic station and varying this arrival time value until all the input data converged to a solution. Results of the graphical solutions and those from the computer program were in excellent agreement. Author

N65-22420# Cornell Univ., Ithaca, N. Y. School of Civil Engineering

TROPICAL SOILS: CHARACTERISTICS AND AIRPHOTO INTERPRETATION Final Report

Ta Liang 31 Aug. 1964 187 p refs

(Contract AF 19(628)-291)

(AFCRL-64-937; AD-613555)

To facilitate engineering studies of tropical soils, and particularly their airphoto interpretation, a classification system is proposed which covers major groups of soils peculiar to the Tropics, soils common in both tropical and subtropical regions, and soils common in all climates. The origin and formation of tropical soils and their relation to climate, parent material, topography, and age are reviewed. The physical and chemical characteristics, and engineering problems of each of the major soil groups are examined. A method of airphoto interpretation by direct recognition of soil features, and by

inference gained from observation of soil-forming factors and circumstances is presented. Air and ground photographs from Central and South America, Tropical Africa, Southeast and South Asia, and Australia are included to illustrate a cross section of the major soil groups in the Tropics. Recommendations are made for further study toward refining the air-photo interpretation of the major groups and subgroups of tropical soils, in addition to the supplementary use of other remote sensing devices. Author

N65-22464# Suffield Experimental Station, Ralston (Alberta).
ROTOROD SAMPLER COLLECTION EFFICIENCY FOR NOMINAL 55 MICRON AND 24 MICRON DIAMETER MICROSPHERES
E. R. Walker, C. H. H. Diehl, M. G. Dudley, and E. E. Howlett
18 Jan. 1965 15 p refs
(Suffield-TN-143; AD-456998)

The collection efficiency of rotorod samplers in collecting glass spheres with mass mean diameters of 55μ and 24μ was tested under field conditions. Diffusing plumes of spheres emitted by an elevated source were completely bracketed by a rectangular sampling grid arrayed crosswind and in the vertical. The mass fluxes through the sampling grid as measured by the rotorod samplers were compared with emission amounts. The collection efficiency of rotorods on the 55μ diameter spheres was estimated at 109% with a probable error of ±17%. The collection efficiency of rotorods on the particular 24μ diameter population was estimated at 60% with a probable error of ±10%. Author

N65-22497# Army Electronics Labs., Fort Monmouth, N. J. Exploratory Research Div.
GEOLOGICAL INVESTIGATIONS RELATED TO SELECTION OF A VLF ANTENNA SITE, WHITE SANDS MISSILE RANGE, NEW MEXICO
John W. Walker Oct. 1964 16 p refs
(ECOM-2530; AD-611104)

Results of a field reconnaissance of the geology and hydrologic conditions in the vicinity of the White Sands Missile Range, New Mexico, are presented. The findings are evaluated with respect to the selection of a site for an experimental vlf antenna which will be placed directly on the surface of the ground. Several rock types exposed on the missile range and various terrains are discussed. The most suitable of these is a cuesta area on the west-flank of the San Andres Mountains exposing the San Andes limestone above the water table. Recommendations for more definitive geophysical evaluations of the area are presented. Author

N65-22502# Central Lab. for Radiological Protection, Warsaw (Poland). Radioactive Contamination Control Div.
STRONTIUM-90 IN TAP WATER AND IN SOME RIVERS IN POLAND, 1962
R. Szepke, D. Grzybowska, A. Raczkowska, and I. Kociszewska
1964 13 p refs
(CLOR-32)

In 1962 the strontium 90 content in tapwater in Warsaw City was estimated as 0.69 ±0.08 pc/liter. In the fall of 1962 the concentration of strontium 90 in some rivers was 0.88 ±0.15 pc/liter. The data obtained are tabulated and plotted on diagrams. Author

N65-22521# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Photographic Interpretation Research Div.
[PHOTOINTERPRETATION TECHNIQUES USED IN AERIAL AND GROUND RECONNAISSANCE OF SEA, SOIL, ICE, SNOW, AND VEGETATION SURFACE AND SUBSURFACE FEATURES] Quarterly Progress Report, Jun.–Aug. 1964
[1964] 3 p refs
(AD-460846)

Research projects associated with this program are described. Reported are results of studies on sea ice sensing, soil movement phenomena, ice sounding techniques, a monocycle radar system for measuring thickness of sea and lake ice, a nuclear snow density meter, radioactive contamination effects on vegetation, arctic vegetation in Alaska, Yukon flats terrain, primary succession in Alaskan lakes, and mobility environmental research. The objective of the overall program is to conduct research into methods and techniques of using various energy forms and/or systems to obtain information about surface and subsurface features in all environments for engineering, scientific, and military purposes. S.C.W.

N65-22529# Joint Publications Research Service, Washington, D. C.
THE STUDY OF EARTH TIDES
N. N. Pariyskiy, ed. 29 Mar. 1965 168 p refs Transl. into ENGLISH of the book "Izucheniye Zemnykh Prilivov" Moscow, 1964 p 3–114
(JPRS-29320; TT-65-30602) CFSTI: $5.00

A treatise is presented on the tidal changes of acceleration of gravity which includes observations made in various areas and at different periods in the Soviet Union and an evaluation of the instrumentation used in the observations. For individual titles see N65-22530–N65-22540.

N65-22530 Joint Publications Research Service, Washington, D. C.
TIDAL CHANGES OF ACCELERATION OF GRAVITY AT FRUNZE
S. N. Barsenkov, V. A. Volkov, D. G. Gridnev, and N. N. Pariyskiy *In its* The Study of Earth Tides 29 Mar. 1965 p 1–44 refs (See N65-22529 12-13) CFSTI: $5.00

The observation station, instruments, method, and calibration of the instrumentation for the observation of tidal changes of the acceleration of gravity carried out at the seismic station at Frunze, U.S.S.R., is described in detail. Continuous recording with one gravimeter lasted 227 days and with a second gravimeter continued for 195 days. The record of the change of acceleration of gravity was made as a trace on photopaper. The ordinates were read from the trace each hour. Corrections for nonlinearity were introduced into all the measured ordinates. Corrections for nonlinearity of the galvanometer scales are summarized. Other corrections and calibration adjustments are given extensive treatment. E.E.B.

N65-22531 Joint Publications Research Service, Washington, D. C.
GRAVIMETRIC OBSERVATIONS AT KIEV DURING THE SOLAR ECLIPSE OF 15 FEBRUARY 1961
Yu. S. Dobrokhotov *In its* The Study of Earth Tides 29 Mar. 1965 p 45–64 refs (See N65-22529 12-13) CFSTI: $5.00

The correctness of the hypothesis of the screening of gravity by matter is checked systematically by observations of the state of the gravity field at the time of solar eclipses. At the points on the earth's surface covered by the luner shadow the

screening effect should be manifested in a change of gravity and in the appearance of tilts. Observations were made at the time of the eclipse at Kiev from 0657 hours to 0924 hours. Photographs of the records of the gravimeter readings are presented. An attentive study of these records does not reveal any peculiarities during the eclipse which could be attributed to the manifestation of the screening effect. More sensitive instrumentation and a lower level of interference are required to demonstrate the effect for which this experiment was conducted. E.E.B.

N65-22532 Joint Publications Research Service, Washington, D. C.

MEASUREMENTS OF TIDAL VARIATIONS OF GRAVITY AT MOSCOW

B. P. Pertsev and M. V. Ivanova *In its* The Study of Earth Tides 29 Mar. 1965 p 65–70 refs (See N65-22529 12-13) CFSTI: $5.00

Measurement of tidal variations of gravity were made from mid-November 1959 through early April 1960. The record of the tides was registered on a photoelectric recorder at a record scale of about 4 microgal/mm. The rate of paper movement in the recorder was 6.8 mm/hr. In the second half of January 1960, the quality of the tidal record worsened considerably due to maladjustments of the recorder. Therefore, the results of only the first 2 months of observations are cited. Harmonic analysis for the observations was made for a 29-day period and data are presented. E.E.B.

N65-22533 Joint Publications Research Service, Washington, D. C.

RESULTS OF TILTMETER OBSERVATIONS IN THE KAZAN' AREA IN 1960–1962

A. Ye. Ostrovskiy, L. I. Mironova, and I. A. Urasina *In its* The Study of Earth Tides 29 Mar. 1965 p 71–84 refs (See N65-22529 12-13) CFSTI: $5.00

Three series of observations of tidal tilts are discussed. The first was conducted for 2 years using pendulums with a sensitivity of 50 mm/sec. The second, consisting of 14 monthly series, was analyzed by the Pertsev method with displacements of the central day by one day. The third, consisting of four monthly series, was analyzed with displacement of the central day by one hour. The observations of the third series were made with azimuth of 0° and 90°. In the last two series, the observations were made with a tiltmeter with photoelectric recording and a sensitivity of 300 to 500 m/sec of arc. Results for all three series of observations are presented. E.E.B.

N65-22534 Joint Publications Research Service, Washington, D. C.

TIDAL TILTS MEASURED WITH PARALLEL INSTRUMENTS

A. Ye. Ostrovskiy and S. M. Fandyushina *In its* The Study of Earth Tides 29 Mar. 1965 p 85–92 refs (See N65-22529 12-13) CFSTI: $5.00

Observations of tidal tilts of the earth's surface made in Central Asia during the IGY period revealed that the value of the tidal tilt changes greatly from place to place. In order to determine what part of these differences can be attributed to the instrumentation and what part is dependent on the place of observation, observations were made with instruments set up on a steel plate and parallel to one another. The sensitivity of the tiltmeters was about 1000 mm/sec of arc or 0.001 sec of arc/mm. A curve of tidal tilts recorded by the two instruments shows very good agreement. It was calculated that the error introduced by the instruments during the measurements did not exceed ±1%. E.E.B.

N65-22535 Joint Publications Research Service, Washington, D. C.

TIDAL TILTS ON THE BASIS OF TWO-DAY SERIES OF OBSERVATIONS

A. Ye. Ostrovskiy and S. M. Fandyushina *In its* The Study of Earth Tides 29 Mar. 1965 p 93–96 refs (See N65-22529 12-13) CFSTI: $5.00

The measurement of tidal tilts on the basis of a 2-day series of observations using a tiltmeter with photoelectric recording is reported. The observations were made near Moscow in abandoned stone quarries at a depth of about 15 meters. Four tiltmeters were set up in two chambers situated 30 meters from one another. In each chamber, one instrument was set up in the N–S direction and one in the E–W direction. Good agreement in the mean value for the tidal tilt was obtained between the two chambers. Further, a considerably longer series of measurements were made in these same chambers extending over a period of from 9 months to 1 1/2 years. Preliminary analysis of the long series gave values very close to those obtained from the short measurement period; differences fall well within the limits of the measurements. It was concluded that the 2-day method of harmonic analysis makes it possible to use a monthly series of observations to obtain several independent values of the tidal tilt. E.E.B.

N65-22536 Joint Publications Research Service, Washington, D. C.

FIELD CHECKING OF THE GRADUATION VALVE OF THE READING DEVICE OF GS-11 GRAVIMETERS

Yu. S. Dobrokhotov *In its* The Study of Earth Tides 29 Mar. 1965 p 97–101 refs (See N65-22529 12-13) CFSTI: $5.00

Field measurements are described for determining the graduation values of gravimeters used for earth tide observations. Data are presented to show that no systematic changes were detected which would indicate a gradual or jumplike change in the graduation value of the gravimeter scales. The values for the zero graduation fall within the limits of measurement error and their maximum deviations from the mean do not exceed 0.1% to 0.2%. Further, it was concluded that, in almost 5 years of work with the gravimeters, the parameters of their sensing systems and measuring devices remained virtually unchanged. E.E.B.

N65-22537 Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE PHASE CHARACTERISTICS OF THE GRAVIMETER–GALVANOMETER TIDE–RECORDING SYSTEMS

V. A. Volkov *In its* The Study of Earth Tides 29 Mar. 1965 p 102–119 refs (See N65-22529 12-13) CFSTI: $5.00

The determination of the phase characteristics of a gravimeter–galvanometer system by the use of the Fourier integral is discussed. The results of the determination of the instrumental phase shift by the Fourier integral method and of the computation of the phase lag of the tidal waves obtained from observations at different stations are tabulated. The difference determines the lag of the tidal waves in the changes of gravity as a result of the earth's viscosity. These data show that the phase characteristics of the three instruments were determined with an error ±0.04 to ±0.05°; for a fourth instrument the error was ±0.13°. Further, it is shown that the instrumental phase lag is a considerable part of the phase lag of tidal waves obtained from harmonic motion. E.E.B.

N65-22538 Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF THE INFLUENCE OF RANDOM OBSERVATIONAL ERRORS ON THE RESULTS OF DETERMINATION OF THE AMPLITUDES AND PHASES OF ELASTIC TIDAL WAVES
M. V. Kramer *In its* The Study of Earth Tides 29 Mar. 1965 p 120–139 refs (See N65-22529 12-13) CFSTI: $5.00

Experiments were conducted to determine the influence of random observational errors on the amplitude and phase of tidal wave measurements. It is shown that to obtain results with an accuracy of 0.3% to 0.4% it is necessary to develop more differential methods of analysis. Further, it was concluded that important errors in the results of tilt observations require the observations to be made over an extended period of time. The following method was recommended. Each day six analyses are made with displacement of the mean moment by 1 hour. The electronic computer prints out the mean of these six analyses each day. Thus, short period 3-hr and 6-hr variations are excluded from the values of amplitude and phase.
E.E.B.

N65-22539 Joint Publications Research Service, Washington, D. C.
INVESTIGATIONS OF A STATIONARY QUARTZ GRAVIMETER WITH PHOTOELECTRIC RECORDING OF READINGS
G. Gridnev *In its* The Study of Earth Tides 29 Mar. 1965 p 140–158 refs (See N65-22529 12-13) CFSTI: $5.00

Temperature compensation, current stability, thermostatic control, and torsion angle are considered for the quartz gravimeter and associated photoelectric recorder. Three gravimeter models were investigated with torsion angles of 360°, 625°, and 825° in the first model, 270° and 990° in the second model, and 990° and 1350° in the third. It was concluded that in the case of a stationary quartz gravimeter, it is more advantageous to use systems with large torsion angles for the fibers of the pendulum suspension (800° to 1000°), load the system somewhat, and compensate some loss of angular sensitivity of the system by an increase of photoelectric sensitivity.
E.E.B.

N65-22540 Joint Publications Research Service, Washington, D. C.
DIFFERENCE IN THE VALUES δ OBTAINED FROM HARMONIC ANALYSIS BY THE LEKOLAZE METHOD
Yu. K. Sarycheva *In its* The Study of Earth Tides 29 Mar. 1965 p 159–164 ref (See N65-22529 12-13) CFSTI: $5.00

In the harmonic analysis of the monthly series of observations of tidal variations of gravity, the results obtained in many cases have not been consistent from series to series for the same location. Further, the scatter of values exceeded the limits of the expected accuracy. The results of a series of such measurements whose central moment was displaced by 1-hr in an interval of 15 days are reported. Dependence of the amplitude difference upon the time of the central moment of the series for the case of the observed and the theoretical tide are presented. The reasons for the variability displayed were not established. However, it appeared that greater reliability can be achieved by carrying out the harmonic analysis of the observational data using the smallest possible interval between central moments of the series, i.e., selecting the greatest possible number of series from the observational data and then averaging the values obtained as a result of the analysis. E.E.B.

N65-22567*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOL. 5, NO. 4
28 Feb 1965 20 p
(NASA-TM-X-56347; X-533-63-1) CFSTI: HC $1.00/MF $0.50

Orbital elements are reported for satellite objects in orbit, and a list of objects that decayed during this period is given. The data were computed and compiled by Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory as of 1200Z on February 28, 1965.
M.P.G.

N65-22570# White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
1963 TECHNICAL PAPERS—GEODETIC WORKING GROUP
Jul. 1964 70 p refs
(IRIG-105-64; AD-444997)

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N65-22571 Air Force Cambridge Research Labs., Bedford Mass.
GEODETIC RESEARCH IN THE SPACE AGE
Owen W. Williams *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 1–8 (See N65-22570 12-13)

New geodetic techniques and measurement devices which offer promise of greater accuracy, speed, and efficiency in charting related geodetic requirements are reviewed. Cartography, electronic surveying, flare triangulation, airborne gravity surveying, satellite geodesy, lasers, and geodectic applications are considered.
E.E.B.

N65-22573 Naval Oceanographic Office, Washington, D. C.
GLOBAL GRAVITY
Albert L. Mc Cahan *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 13–16 (See N65-22570 12-13)

The requirements for terrestrial gravity data extrapolated to heights above the surface of the earth; the present effort on acquisition of these data and their application to missile test range requirements; and future plans for a global gravity program are presented. It was concluded: (1) Land gravity survey instrumentation is presently satisfactory to meet test range requirements. (2) Ocean gravity survey instrumentation is not completely satisfactory except in shallow water but can provide data as presently required for range use. (3) Airborne gravity survey instrumentation is still in the test and evaluation stage but shows promise of being operational with certain limitations within the next year. (4) Continued satellite development will probably provide accurate gravity information for the general picture of the earth's field. (5) Present effort is substantial and promises to expand. (6) The Department of Defense has an established gravity program which gives test range requirements specific attention.
E.E.B.

N65-22574 Pacific Missile Range, Point Mugu, Calif.
SHIP LOCATION AND HYDROPHONE SYSTEMS
Barrett H. Erickson *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 17–19 refs (See N65-22570 12-13)

Ship positioning requirements and types of electronic, acoustic, satellite, and miscellaneous positioning systems are discussed. Satellite methods provide noncontinuous position reference, which may be used to establish the absolute positions of permanent features or of artificial markers used as a full-time navigation reference. Alternatively, a ship may carry its position between satellite fixes by dead reckoning methods. Flare triangulation methods are also in this category. Artificial markers are only capable of giving a relative position unless the markers themselves have been located by other means. A system which uses hydrophones singly or in arrays to receive the sound of a missile impact on the surface of the ocean or the sound of a detonation is considered. These hydrophones have been located with a high relative accuracy. Other types of artificial markers may include radar or instrumentation buoys.
E.E.B.

N65-22575 Atlantic Missile Range, Patrick AFB, Fla.
HIGH ORDER GROUND SURVEYS ON THE ATLANTIC MISSILE RANGE
William Noble Martin *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 21–34 (See N65-22570 12-13)

Ultrahigh-order ground surveys were accomplished in 1960 in the survey for the Azusa Mark II ballistic camera checkout. The gear and methods devised to raise and use the geodimeter on a steel tower enabled any or all lines in the triangulation scheme to be measured precisely in terms of the speed of light. By the combination of a number of geodimeter lines, refining the triangulation observations, and increasing all observations to a minimum of 2 nights, together with a strong geometry in the figures, an average probable error of about 1 part in 10^6 between the camera stations was determined. The Grand Bahama Island–Great Abaco Island survey; high-order base, Cape Kennedy to Homestead; and Valkaria MISTRAM are also discussed. The baseline requirements for the Valkaria MISTRAM required two, 20-mile bases at approximately right angles, and two, 2-mile bases along these approximate lines. The specifications require a program of remeasuring the 10K bases at gradually increasing time intervals in order to detect movement of the survey marks. A backward measurement of the 10K bases recently completed showed a very close check between the forward and backward measurements, 0.07 mm on the west 10000-foot base and 0.4 mm on the east 10000 foot base.
E.E.B.

N65-22576 National Aeronautics and Space Administration, Washington, D. C.
LUNAR AND SPACE GEODETIC APPLICATIONS
Lyle R. Dickey *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 35 (See N65-22570 12-13)

Some of the lunar and space geodetic problem areas that need investigating, and a few applications that may warrant more detailed consideration are discussed. Since inertial navigation and geodesy complement each other, and geodetic information is fed into guidance computers, a comparison of the navigation theories and guidance systems for lunar vehicles is suggested. Such a comparison could provide considerable insight into the significance of geodetic methods and computer input accuracies, and determine future courses of action. Also, the precision of precomputed trajectories, onboard guidance computers, electronic tracking methods, and lunar and planetary navigation are to a considerable extent based on the accuracy of the earth's equatorial radius, the earth's gravitational potential, and the lunar and solar parallax.
E.E.B.

N65-22577 Naval Oceanographic Office, Washington, D. C.
SUMMARY OF PROGRESS IN GRAVITY ACTIVITIES IN THE UNITED STATES
A. L. Mc Cahan *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 37–57 (See N65-22570 12-13)

Land observations including general surveys, base station networks, and calibration lines; sea observations including test and evaluation of existing instruments, development of new instruments, and general surveys; and information derived from satellites and theoretical studies are the major areas of gravity research. Each of these categories is considered. Also, studies are underway on the storage, retrieval, and use of gravity data. Punched cards are being adopted generally for data storage and retrieval, and for recording reference information necessary to correlate all data to a common system. For survey use at sea and in the air equipment for presenting data on tape is being developed which is compatible with data handling equipment in the office. Programs are also being developed to process data by means of high-speed computers.
E.E.B.

N65-22582*# National Aeronautics and Space Administration, Washington, D. C.
PECULIARITIES OF ION FORMATION IN THE F-REGION OF THE IONOSPHERE AND ANOMALIES OF THE COMPOSITE F-LAYER [OSOBENNOSTI IONOOBRAZOVANIYA V OBLASTI F IONOSFERY I ANOMALII SLOZHNOGO SLOYA F]
L. A. Shchepkin Apr. 1962 14 p refs Transl. into ENGLISH of Sect. V of the IGY Program, Ionosphere, no. 6 Moscow, Publ. House of the USSR Acad. of Sci., 1961 p 9–16 (NASA-TT-F-8217) CFSTI: HC $1.00/MF $0.50

Analysis is made of the altitude and time dependence of the distribution of ion formation intensity in the ionosphere in the case of a complex nonlinear altitude dependence of temperature when only a single gas component is ionized by a quasi-monochromatic radiation. It is shown that when the upward movement is accompanied by an abrupt decrease of the temperature gradient, the formation of two maxima of ion production is possible within a certain interval of the sun's zenith angles. The required conditions for the occurrence of such effect may take place in the F-region of the ionosphere. It appears possible to explain in such a case a number of important features of F_1- and F_2-layers' behavior by the specific features of the fundamental photoionization process of the atmosphere at the F-region level.
Author

N65-22588*# National Aeronautics and Space Administration, Washington, D. C.
TWILIGHT ENHANCEMENT OBSERVATION OF THE INFRARED HELIUM LINE 10830 Å [NABLYUDENIYE SUMERochnoy VSPYSHKI INFRAKRASNOY LINII GELIYA 10830 Å]
P. V. Shcheglov 22 Jun. 1962 5 p ref Transl. into ENGLISH from Astron. Zh. (Moscow), v. 39, no. 1, 1962 p 158–159 (NASA-TT-F-8245) CFSTI: HC $1.00/MF $0.50

Twilight sky glow in the line 10830 Å was observed in February 1961 by an interference monochrometer. This consisted of a dielectric light filter at λ = 10830 Å, behind which an étalon with an instrumental contour near 2 Å was disposed. This étalon served only as an indicator of monochromatic emission and did not disturb the triplet structure of the investigated line. The image of the interference patterns was received on the cathode of an electron-optical converter. The absence of fringes in the last of three photos substantiated the fact that exactly the twilight enhancement of the line 10830 Å is registered. The same observation procedure in April 1960 showed a slower decrease in the helium line intensity, which is explained by a greater twilight duration than occurs in wintertime.
G.G.

N65-22592*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF THE VERTICAL INHOMOGENEITY OF THE EARTH'S MAGNETIC FIELD ON THE HIGH FREQUENCY CHARACTERISTICS OF THE IONOSPHERE [VLIYANIYE VERTIKAL'NOY NEODNORODNOSTI ZEMNOGO MAGNITNOGO POLYA NA VYSOTNO-CHASTOTNYYE KHARACKTERISTIKI IONOSFERY]

V. N. Kessenikh 20 Apr. 1963 5 p refs Transl. into ENGLISH from Ionospherical Res. no. 6, sect. v of the IGY Program (USSR) p 7–8

(NASA-TT-F-8216) CFSTI: HC $1.00/MF $0.50

The effect on the parameters of the high-frequency curves of the ionosphere of the earth's magnetic field's vertical inhomogeneity are further developed. It is shown that the presence of a vertical gradient of the earth's magnetic field intensity in the region of slow variation of electron concentration in the ionosphere may result in a notable change of the actual height corresponding to the critical frequency of the extraordinary ray. Author

N65-22595*# National Aeronautics and Space Administration, Washington, D. C.

NITROGEN DISSOCIATION IN THE UPPER ATMOSPHERE [K VOPROSU O DISSOTSIATSII AZOTA V VERKHNEY ATMOSFERE]

A. D. Danilov 9 Apr. 1962 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. I, no. 2, 1961 p 174–177

(NASA-TT-F-8207) CFSTI: HC $1.00/MF $0.50

Possible ways of atomic nitrogen formation in the upper atmosphere are examined. It is shown that photochemical reactions lead to a high rate of nitrogen formation at 200- to 300-km altitudes. On the basis of experimental data, an estimate is made of the number of nitrogen atoms in the atmosphere column above 200 km. The distribution of N concentration with altitude is obtained. Author

N65-22598*# National Aeronautics and Space Administration, Washington, D. C.

GEOGRAPHICAL DISTRIBUTION AT LOW LATITUDES OF CRITICAL FREQUENCIES OF THE F_2-LAYER [K VOPROSU O GEOGRAFICHESKOM RASPREDELENII KRITICHESKIKH CHASTOT SLOYA F_2 NA NIZHNIKH SHIROTAKH]

L. A. Shchepkin Jun. 1962 6 p refs Transl. into ENGLISH frm Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 2, 1962 p 365–367

(NASA-TT-F-8248) CFSTI: HC $1.00/MF $0.50

The causality between the geographical distribution of f_0F_2 at low latitudes and the zenith angle of the sun was investigated, with the geomagnetic coordinates considered. Daily shifts of a f_0F_2 maximum were compared to the patterns of latitude distribution of the F_2-layer's critical frequencies in the Northern and Southern hemispheres at different hours of the day. It was concluded that the f_0F_2 maxima form in the summer and winter hemispheres due to electron–ion gas flows in an horizontal direction, and the variations in the F_2-layer formation as a function of the sun's zenithal angle at various latitudes. The difference in the mechanisms of f_0F_2 maximum formation in different hemispheres may be the cause of the greater maximum in the winter hemisphere as compared to the summer hemisphere. Interpretation of the daily course of f_0F_2 on the basis of atmospheric ionization in the F-region established that the farther from the equator in wintertime, the closer to midday the described transition must take place. G.G.

N65-22599*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF ELECTRIC CURRENTS INDUCED IN THE EARTH, ON THE SIZE AND FORM OF MIDNIGHT SUDDEN COMMENCEMENTS OF MAGNETIC STORMS [VLIYANIYE ELEKTRICHESKIKH TOKOV, INDUTSIRUYEMYKH V ZEMLE, NA FORMU I VELICHINU VNEZAPNYKH NACHAL MAGNITNYKH BUR']

K. G. Ivanov Jun. 1962 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 2, 1962 p 367–368

(NASA-TT-F-8249) CFSTI: HC $1.00/MF $0.50

A comparison of magnetograms and tellurograms of the magnetic observatory at Maytun showed that the commencement of magnetic storms begins near midnight and has the expected tellurogram form. The strength of the electric field E, induced by a sudden commencement on earth, can be estimated by the formula $E \sim (dH)/(dt)$, where dH/dt is the rate of H-component variation during magnetic storm commencement. It was concluded that the magnetic field of currents induced in the earth during magnetic storm commencement increases the value of the near-midnight magnetic storm development by ~ 30% and imparts to them a hooklike form. G.G.

N65-22600*# National Aeronautics and Space Administration, Washington, D. C.

ANOMALOUS ABSORPTION AT HIGH LATITUDES OF THE SOUTHERN HEMISPHERE [ANOMAL'NOYE POGLOSHCHENIYE V VYSOKIKH SHIROTAKH YUZHNOGO POLUSHARIYA]

G. V. Bukin Jun. 1962 4 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 2, 1962 p 368–369

(NASA-TT-F-8250) CFSTI: HC $1.00/MF $0.50

Data on ionospheric effects of 16 solar flares, collected from vertical soundings in the Southern hemisphere from July 1957 through September 1958, are presented. Comparison of chromospheric flares, solar radio emission, and absorption in the Northern and Southern hemispheres shows the following: (1) The Delinger effect was only detected in two cases in the Southern hemisphere. (2) The commencement time of the type III absorption for the two hemispheres differs markedly. (3) The lower boundary of anomalous absorption latitudes reaches about 58.5° N in the Northern and 54° S in the Southern hemisphere. (4) The duration of the blackouts caused by the same flare may be essentially different in both hemispheres. G.G.

N65-22603*# National Aeronautics and Space Administration, Washington, D. C.

ELECTRON DENSITY FLUCTUATIONS IN THE IONIZATION ZONES OF AURORAE [FLUKTUATSII ELECTRONNOY PLOTNOSTI V ZONAKH IONIZATSII POLYARNYKH SIYANIY]

V. I. Pogorelov 16 Jul. 1962 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. II, no. 1, 1962 p 68–70

(NASA-TT-F-8259) CFSTI: HC $1.00/MF $0.50

The mean-square value of fluctuations of electron concentration in the zones of formation of ultrashort-wave reflections during aurorae is computed. The estimate, made as a result of experimental data analysis from the standpoint of diffusion theory, leads to absolute values of fluctuations reaching 10^5 electron/cm^3. Author

N65-22604*# National Aeronautics and Space Administration, Washington, D. C.
THE PROMINENT POLAR AURORA OF 11 FEBRUARY 1958 [VYDAYUSHCHEYESYA POLYARNOYE SIYANIYE 11. II. 1958 G.]
L. S. Yevlashin 16 Jul. 1962 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. II, no. 1, 1962 p 72–78
(NASA-TT-F-8258) CFSTI: HC $1.00/MF $0.50

Observations of the type-A red aurora of February 11, 1958 at Murmansk are discussed. Thirty-seven spectra were obtained during the initial phase of the aurora (0100 to 0500 hrs GMT); further observation was prevented by the sunrise. Comparison of the separate development stages of the initial phase with geomagnetic field variations shows that the basic phase of the geomagnetic disturbance commenced suddenly at 0125 hrs, whereas the aurora developed gradually. The aurora was the most prominent observed at Murmansk from 1957 to 1961, but the intensity of the accompanying geomagnetic disturbance was not unusual. The unusual red aurora spectrum was obtained for the first stage (0009 hrs) of aurora development, but the second (0145 hrs) and third (0409 hrs) stages were characterized by particularly strong λ 6300 and 5577 A lines, 1 NG N_2^+ bands, and also NII λ 5000 A, N_β^ϕ 4861 A and [NI] λ 5200 A emissions. Other peculiarities of this aurora were the predominance of the λ 6300 A line over the λ 5577 A line, the disappearance of λ 4861 A and 5000 A emissions, the enhancement of the λ 5200 A line, and the development of an oscillating–rotating structure of the 1 NG N_2^+ bands. These data suggest that this aurora was caused by a stream of particles of exceptionally high density but whose mean energy was usual. M.P.G.

N65-22662# American Meteorological Society, Boston, Mass.
THE DAMPING OF THE ELECTROMAGNETIC EIGENOSCILLATIONS OF THE EARTH-AIR-IONOSPHERE SYSTEM [UBER DIE DAMPFUNG DER ELEKTROMAGNETISCHEN EIGENSCHWINGUNGEN DES SYSTEMS ERDE-LUFT-IONOSPHARE]
Winfried Otto Schumann Bedford, Mass., AFCRL, Aug. 1964 9 p refs Transl. into ENGLISH from Z. Nautrforsch. (Tübingen), v. 7a, 1952 p 250–252
(Contract AF 19(628)-3880)
(T-G-224; AD-454626)

This paper describes the derivation of an approximation formula for the damping of the lowest eigenfrequencies of the earth-air-ionosphere system, from whose measurement the effective height of the air layer and the effective conductance of the ionosphere can be determined. Author

N65-22691# Emmanuel Coll., Boston, Mass. Research Language Center
THE MICROSTRUCTURE OF TURBULENCE IN THE LOWER TROPOSPHERE
Chia-i Chen, Tan Sin, and Su-zeng Dong [1963] 25 p refs Transl. into ENGLISH from Acta. Met. Sinica (Peking), v. 33, no. 2, 1963 p 271–280
(Contract AF 19(628)-3869)
(E-T-CH-64-16; AD-611032)

This paper analyzes Deviatova's experimental data of the horizontal wind speed fluctuations at different heights from 100 to 1470 m. The main results are: (1) The horizontal wind speed fluctuations at any height may be approximated by a Gaussian distribution. (2) For heights up to a few hundred meters, the well-known "2/3" law holds within a scale of length comparable to or several times larger than the height. (3) At higher levels, the scale range in which the "2/3" law holds in usually less than the height itself and no definite relationship between this range and the height has been found. The validity of the data is also discussed. Author

N65-22703# Washington Univ., Seattle. Dept. of Atmospheric Sciences
PRELIMINARY STUDIES OF FORMATION AND STABILITY OF CONCENTRATED VORTICES NEAR THE GROUND
K. H. Bergman, J. A. Turner, and J. A. Businger Dec. 1964 37 p refs
(Grant DA-AMC-36-039-63-G1)
(AD-611337)

The report summarizes the present status of a continuing investigation into the mysteries of the small-scale atmospheric vortex, usually known as the "dust devil" or "whirlwind" Many of the basic concepts of vortex flow presented apply to the larger scale tornado as well. TAB

N65-22707# Emmanuel Coll., Boston, Mass. Research Language Center
SOVIET GEOPHYSICAL EXPLORATIONS IN THE ANTARCTIC [SOVETSKIE RAZVEDOCHNYE GEOFIZICHESKIE ISSLEDOVANIIA V ANTARKTIKE]
S. A. Ushakov May 1964 23 p Transl. into ENGLISH from Rezul'taty Issled. po Programme MGG, Gravimetria (USSR), no. 4, 1963 p 22–30
(Contract AF 19(628)-3869)
(E-T-R-64-29; AD-611122)

An historical review is presented of seismic determinations of Antarctic ice thickness, gravimetric observations of the Antarctic continent, nautical gravimetric studies, and magnetosurvey operations. The number of expeditions, the principal investigators, the equipment used, the geographical areas covered, and general observations are given for each type of survey. M.P.G.

N65-22716 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE IONOSPHERE WITH ROCKETS AND SATELLITES
R. Ye. Burdo, Dzh. Chepmen, and K. Mayeda *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 63–124 refs (See N65-22713 12-30)

A comprehensive review is presented of the results of ionospheric studies made with sounding rockets and satellites and of the research methods and instrumentation used in obtaining them. Sounding rocket results presented include characteristics of the neutral atmosphere, electron and ion concentrations in the D, E, and F_2 regions, disturbances in the D region, intensity of solar radiation in the E and lower F regions, generation and propagation of ions in the lower ionosphere, and electron temperature measurements. Satellite results discussed include measurements in the upper ionosphere of electron temperature, ionic composition, local charged particle concentration, plasma peaks, the equatorial anomaly, and the F diffusion layer. Discussions of research methods and the types of rockets and satellites using them include the radio sounding method, radio apparatus for probing the ionosphere above the F_2 maximum, Langmuir probes and problems in using them on space vehicles, resonance probes and their limitations, the short radio-frequency rod antenna, applications of the Doppler frequency shift and the Faraday effect, and the radio wave intensity and propagation times methods. Areas of ionic research included in the International Quiet Sun Year program are listed. M.P.G.

N65-22720 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME RESULTS FROM THE DETERMINATION OF THE GEOGRAPHIC DISTRIBUTION OF CURRENTS OF ASCENDING THERMAL RADIATION FROM THE GROUND AND THE ATMOSPHERE FOR SPECIFIC SYNOPTIC SITUATIONS

K. Ya. Kondrat'yev and Kh. Yu. Niylisk *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 175–202 refs (See N65-22713 12-30)

Calculations are presented of the geographic distribution of atmospheric thermal radiation moving away from the earth in four spectral segments (2.27 to 250; 4.88 to 8.70; 10.55 to 11.01; 12 to 18μ) for various specific synoptic situations. Quantitative data were obtained on the spatial variation in outgoing radiation, and the relationships between the features of the radiation field and the synoptic situation were analyzed. The possibilities of determining the temperature of the ground surface were studied with data on outgoing radiation in various spectral regions. Author

N65-22726 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIRECT MEASUREMENTS OF CHARGED-PARTICLE CONCENTRATION IN THE STRATOSPHERE AND MESOSPHERE

Yu. A. Bragin *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 274–281 refs (See N65-22713 12-30)

Two methods of measuring the ion concentration were used in rocket experiments at altitudes from 20 to 80 km. The first method involved an adaptation of a device previously developed for studying the ion composition of air near the ground. In this method, atmospheric air flows through a cylindrical capacitor past a central cylindrical collector that is parallel to the flow. The second method used a cylindrical airflow intake tube and a collector plate a short distance from the end of the tube perpendicular to the flow. In both experiments, the potential of the forward entry parts of the pickup was selected to eliminate edge effect errors. Rocket experiments using these methods indicate an elevated charged particle content in the atmosphere from 15 to 40 km. Intense secondary cosmic radiation at 20 to 30 cm is hypothesized as the source of the observed ionization maxima in this region. M.P.G.

N65-22740 Army Electronics Labs., Fort Monmouth, N. J.

DETERMINATION OF THE IONOSPHERIC ELECTRON CONTENT UTILIZING SATELLITE SIGNALS

Paul R. Arendt, Aristole Papayoanou, and Haim Soicher *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 101–114 refs (See N65-22732 12-34)

Active and passive methods of determining ionospheric electron content from satellite signals are reviewed and compared; the former involve measurements by the satellite itself, the latter by ground stations. The present methodological evaluation is limited to topside ionospheric sounding by active methods, and to continuous wave transmission from the satellite and ground reception by passive methods. Passive techniques are based on determination of Doppler frequencies, or the Faraday phase rotation, or both; study of the equations describing these phenomena shows that none can be used alone for measurement of electron content, and that simultaneous data from different frequencies, data taken at different times, or hybrid methods using both effects, must be introduced into the analysis. In active measurement, numerical integration is used to determine the electron density profile from exponential decay observations on ionograms from the satellite. These methods are illustrated with data from various satellites. J.M.D.

N65-22798# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

COMPARISON OF ROCKET AND ESTIMATED GEOSTROPHIC WINDS AT THE 10-MB LEVEL

Marvin D. Kays Apr. 1965 16 p refs

(ERDA-286; AD-461155)

One hundred and forty-seven comparisons were made between estimated geostrophic winds determined from Sherhag's 10-mb maps and rocketsonde winds at the same level and time. Relative deviations

$$\frac{|\underline{R}-\underline{G}|}{|\underline{R}|}$$

of the rocket wind vector ($\underline{R}$) and estimated geostrophic wind vector ($\underline{G}$) indicate better agreement in summer than winter, but little difference in the agreement of the two winds when parachute and chaff-type wind sensors are used. The relative deviation varies inversely with the wind speed, and the mean relative deviation indicates that the rocket wind vector is some 40% larger than the estimated geostrophic wind. The relative deviation varies from over 100% with wind speeds less than 20 knots to approximately 20% for speeds in excess of 100 knots. Author

N65-22814# Emmanuel Coll., Boston, Mass.

REVISED MAP OF RATES OF RECENT VERTICAL MOVEMENTS OF THE CRUST IN THE WESTERN PART OF THE EUROPEAN USSR AND SOME CONSIDERATIONS ON THE PERIOD OF THESE MOVEMENTS [UTOCHNENNAIA KARTA SKOROTSTI SOVREMENNYKH VERTIKAL'NYKH DVIZHENII ZEMNOI KORY NA ZAPADE EVROPEISKOI CHASTI SSSR I NEKOTORYE SOOBRAZHENIIA O PERIODE ETIKH DVIZHENII]

V. A. Mattskova Bedford, Mass., AFCRL, Jun. 1964 27 p refs Transl. into ENGLISH from Rezul'taty Issled. po Uezhdunarodnym Geofiz. Proektam, no. 1, 1963 p 73–87

(Contract AF 19(628)-3869)

(E-T-R-64-34; TT-65-61705; AD-611036)

Conclusions are: (1) New releveling data and tide-gage data make it possible to revise the map of rates of recent vertical movements of the crust in the western part of the European part of the U.S.S.R. The rates on the revised map vary from −6.3 to +14.6 mm/year, with an error range from 0.7 to 1.1 mm/year. (2) The trend of recent movements in the interval between relevelings is maintained on the whole. (3) From data of releveling repeated over 5–10 years, and also from series of tide-gage observations with durations up to 10 years, exaggerated rates were obtained with errors of the order of magnitude of the rates. (4) To determine the rate of land movement from tide-gage data, only stations with a period of observation greater than 30 years should be used. (5) Relevelings for the study of recent movements should be done over not less than 15 years (this figure should not be extended to seismically active areas). (6) Study of the period of recent movements should proceed on the basis of large quantities of statistical data. TAB

N65-22823# Texas Univ., Austin. Defense Research Lab.

[SOLION SEISMOGRAPHS] Quarterly Status Report, 1 Jan.–31 Mar. 1965

R. H. Wallace 27 Apr. 1965 10 p

(Contract CGS-1198)

(QSR-5)

A new model solion seismometer was built. The addition of a leaf spring, which gives the bellows lateral stability, allows this unit to be used as a horizontal seismometer. This unit is

also being prepared for the addition of an electromechanical shaker for calibration purposes. Some testing was done on this two-way instrument on the shake tables. Recordings were made using a horizontal seismometer which had previously produced noisy records. No excessive noise was observed during this test. A solion was built having an acceptable frequency response, but with a sensitivity of nearly 10 times that of previous units. It may characterize the ideal solion for seismic use. Author

N65-22834# Emmanuel Coll., Boston, Mass.
THE SUNRISE EFFECTS IN THE E AND F LAYERS OF THE IONOSPHERE
Dchao-Shien Dchang Bedford, Mass., AFCRL, Mar. 1964 43 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 12, no. 1, 1963 p 12–31
(Contract AF 19(628)-3869)
(E-T-CH-64-11; TT-65-61680; AD-611029)

Ionograms from station Juliusruh/Rugen in East Germany, recorded 1 minute before and after sunrise during the period November 1958–October 1959, are analyzed. It is concluded that the E_2 layer is a normal layer, controlled purely by solar ultraviolet radiation. The annual variation of the solar height during primary ionization is irregular, whereas the solar height of the F layer has a regular annual variation. A theoretical study of these results shows that there is no screening layer capable of strongly absorbing the relevant solar ultraviolet radiation for both the F and E layers. The maximum electron production rates of the E_1 layer for all months and the extraterrestrial intensities of the solar L_β-radiation related to this layer are calculated. The cause of the E_2 layer formation is also examined. TAB

N65-22837# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
MATHEMATICAL CHARACTERISTICS OF INDIVIDUAL WIND PROFILES
Oskar M. Essenwanger 31 Dec. 1964 47 p refs
(RR-TR-64-12; AD-456880)

The computation of mathematical characteristics to describe the wind profile is discussed. Five polynomial terms are sufficient to represent the wind direction profile with its height variations between 2 and 26 km; three terms of the Fourier series adequately approximate the wind speed profile between the same boundaries. It can be shown, however, that knowledge of two polynomial terms for the wind direction and one Fourier coefficient for the wind speed exhibit the typical features of the wind profile. The application of the method is illustrated with establishment of characteristics for Washington, D.C. (Silver Hill) for the period 1955 to 1959. Two typical mean profiles for the summer, and one for the winter evolve. Author

N65-22839# Emmanuel Coll., Boston, Mass. Research Language Center
MODEL EXPERIMENTS APPLIED TO SEISMOLOGY
Keichi Kasahara Bedford, Mass., AFCRL, Apr. 1964 38 p refs Transl. into ENGLISH from Zisin, Japan, v. 15, p 219–237
(Contract AF 19(628)-3869)
(E-T-J-64-7)

Use of theoretical models in seismological studies of structural geology and related subjects is discussed generally. The relationship between theoretical models and natural observation, use of ratios of physical quantities in model-scaling, choice of measurement methods, and limitations on applicability of models, are described. Classification of model experiments as either direct or analogy is presented. Some future problems in seismic model building are outlined. A bibliography of 88 titles is given on models in seismology. J.M.D.

N65-22857*# National Aeronautics and Space Administration, Washington, D. C.
IONOSPHERE INVESTIGATIONS OVER THE ATLANTIC OCEAN [IONOSFERNYYE NABLYUDENIYA V ATLANTICHSKOM OKEANE]
G. V. Bukin Jul. 1962 5 p ref Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 1, no. 6, 1961 p 832–834
(NASA-TT-F-8253) CFSTI: HC $1.00/MF $0.50

A detailed analysis of vertical soundings of the ionosphere in 1958 to 1959 from shipboard is presented and a latitude cross section of the ionosphere above the Atlantic has been obtained. It was found that the equatorial electron concentration of the F_2-layer fluctuates strongly in daytime in relation to the mean level. The equatorial ionosphere differed substantially from that of middle latitudes, and small latitude shifts led to variations of the daily course of f_0F_2. It is probable that the sharp latitude-dependence of the structure of the F_2-layer is related to the electromagnetic effect of the electrojet flowing in the E-layer. A number of sounding diagrams are included. G.G.

N65-22858*# National Aeronautics and Space Administration, Washington, D. C.
ON THE ANNUAL COURSE OF FREQUENCY OF MAGNETIC STORM OCCURRENCE [O GODOVOM KHODE CHSTOT POYAVLENIYA MAGNITNYCH BYR']
Y. M. Mishin, N. Ya. Naydenova, and T. V. Shchukina Jul. 1962 10 p refs Transl. into ENGLISH from Geomagnetiszm i Aeronomiya (Moscow), v. 2, no. 2, 1962 p 321–325
(NASA-TT-F-8254) CFSTI: HC $1.00/MF $0.50

The dependence is examined of amplitudes and phases of the first harmonics of storm number annual variation upon storms' intensity and the 11-year cycle. The phase of the first harmonic is subject to a cyclical variations with an amplitude near 2π and parallel to Wolf numbers. Together with other facts, this is considered as a consequence of existence in the streams of trapped magnetic fields. The amplitude of the second harmonic of storm number annual variation rises 40% to 50% of the mean-annual level when passing from moderate to major storms. Author

N65-22859*# National Aeronautics and Space Administration, Washington, D. C.
SOME RESULTS OF INVESTIGATIONS IN THE SOVIET UNION OF THE UPPER ATMOSPHERE AND COSMIC SPACE DURING THE IGY WITH THE HELP OF ROCKETS AND SATELLITES [NEKOTORYYE ITOGI ISSLEDOVANIYA VERKHNEY ATMOSFERY I KOSMICHESKOGO PROSTRANSTVA PRI POMOSHCHI RAKET I SPUTNIKOV V TECHENII MGG V SOVETSKOM SOYUZE]
V. V. Mikhnevich Jul. 1962 19 p refs Transl. into ENGLISH from Geophys. Bull. (Moscow), no. 11, 1962
(NASA-TT-F-8255) CFSTI: HC $1.00/MF $0.50

Geophysical and space investigations of the upper atmosphere were conducted by 175 rockets during 1957 to 1959 to gather data on (1) structural parameters of the atmosphere; (2) ionization of the ionosphere and of interplanetary space; (3) magnetic fields of the earth, of the moon, and of interplanetary space; (4) cosmic radiation; (5) ultraviolet, X-, and corpuscular radiations of the sun, diurnal sky luminescence and night-sky glow; and (6) meteor matter. Systematic measurements established the boundaries, the composition of particles, and the radiation intensity of three radiation belts in the earth's magnetic field, provided new data on the anomaly in magnetic field variations, and the electron and ion composition of the atmosphere. The density of the atmosphere was determined to 700-km altitude and found to be 5 to 10 times

higher above 200 km than previously assumed. Measurements of the number of particle collisions and their energy showed a variation in density near earth. Heavy nuclei with a charge above 30 were found in cosmic radiation and it was established that the magnetic field of the moon is about 400 times less intense than at the earth's surface. G.G.

N65-22860*# National Aeronautics and Space Administration, Washington, D. C.
IONOSPHERE INVESTIGATION ON THE SCHOONER "ZARYA" (1960–1961) [ISSLEDOVANIYA IONOSFERY NA SHKHYNE "ZARYA" (1960–1961)]
L. P. Goncharov Jul. 1962 9 p refs Transl. into ENGLISH from Geophys. Bull. (Moscow), no. 11, 1962
(NASA-TT-F-8252) CFSTI: HC $1.00/MF $0.50

Simultaneous mapping of the magnetic fields, registrations of the nucleon component of cosmic rays, and vertical soundings of the ionosphere were made over the Pacific Ocean by a nonmagnetic ship during 1960 to 1961. The obtained ionograms characterize the state of the ionosphere along the path of the ship. F-graphs of the daily course of the critical frequencies of the F_1-layer are presented, including one which shows a sudden total absorption that began after a large flare on the sun. G.G.

N65-22873# Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics
COOPERATION IN SEISMIC MEASUREMENTS OF CRUSTAL STRUCTURE IN MINNESOTA Final Report, 15 Apr. 1963–15 Oct. 1964
B. F. Howell, Jr. [1964] 11 p refs
(Contract Nonr-1661(00); Grant NSF GP-1119)
(AD-610944)

Seismic arrival data from dynamite explosions at preselected points in Lake Superior, Minnesota were gathered. Time of arrival, amplitude, and frequency spectrum data were analyzed. The frequency spectra are similar to those found in experiments made at the Gulf of Maine. No identifiable pattern in the frequent minima in the spectrum has as yet been found. The Minnesota records do not show a strong difference in the spectrum between direct and critically refracted pulses as did the Maine records, possibly indicating that the Mohorovicic discontinuity in Minnesota is sharper than in Maine. Calculated values of the absorption coefficient for the critically refracted pulse range from +0.0055 to −0.0175 per km., and indicate that the absorption coefficient is not dependent on the frequency. The coefficient is slightly smaller than reported by others under similar circumstances. The values of the absorption coefficient for the direct pulse are positive up to above 14 cps. One explanation for this theoretically impossible result is that the assumed spreading factor is in error. The possibility that the ray paths are curved and that their curvatures are a function of frequency is being considered. L.S.

N65-22884# Army Foreign Science and Technology Center, Arlington, Va.
DIURNAL CHANGES OF THE DUST CONTENT OF THE SURFACE LAYER OF THE ATMOSPHERE
C. P. Makhon'ko Dec. 1964 9 p refs Transl. into ENGLISH from RUSSIAN
(FSTC-381-T64-47; AD-611379)

A result of constantly acting wind erosion, radioactive fallout matter, together with soil particles, again enters into the atmosphere, increasing the concentration of radioactive dust in the air. In order to study certain details of this secondary process special model experiments are formulated for clarification of the diurnal variation of the fallout of virtually weightless dust, continuously forming on the underlying surface. The investigation was carried out by the labeled atoms method and conditions were created making it possible to exclude the distorting influence of global fallout. The fallout at a height of 1 M above the earth's surface was recorded automatically on sticky sheets. A simple apparatus with a clock mechanism which wound the sticky sheet at prescribed intervals was used. The experiments were made in the summer in a meadow with a well-developed grass cover. TAB

N65-22890# Emmanuel Coll., Boston, Mass. Research Language Center
RADAR INVESTIGATIONS OF THE STRUCTURE OF THE IONOSPHERE WITH THE SATELLITE "COSMOS" ON COHERENT FREQUENCIES (PRELIMINARY RESULTS) [O RADIOISSLEDOVANIIAKH STRUKTURY IONOSFERY PRI POMOSHCHI ISZ "KOSMOS" NA KOGERENTNYKH CHASTOTAKH (PREDVARITEL'NYE REZUL'TATY)]
Apr. 1964 36 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiia (Moscow), v. 3, no. 1, 1963 p 10–24
(Contract AF 19(628)-3869)
(E-T-R-64-19; AD-611121)

This article shows the results of a preliminary analysis dealing with the differences in the Doppler shift of coherent radio wave frequencies $\delta\Phi$, emanating from satellites Cosmos I and Cosmos II on frequencies of 20.005 and 90.0225 Mc/s. New data have been obtained concerning the gradient of the large scale heterogeneity of the electron concentration N_c along the satellite orbit S and its linear scale. The space modulation $\delta\Phi$ made it possible to determine a general spectrum with the linear dimensions ρ_o of heterogeneous origins of the ionosphere within the 1- to 300-km range and higher. A new maximum was discovered for the spectrum W (ρ_o) of the heterogeneities for $\rho_{om} \approx 100$ to 130 km. The maximum observed earlier for $\rho_{om} \approx 2 + 6$ km is confirmed. Along portions of the orbit where N_c is nearly constant, the angle of refraction, $\delta\phi$ does not vary greatly. Author

N65-22924# Atomic Energy Commission, New York. Health and Safety Lab.
SPECTROMETRIC TECHNIQUES FOR MEASURING ENVIRONMENTAL GAMMA RADIATION
Harold L. Beck, William J. Condon, and Wayne M. Lowder Oct. 1964 79 p refs
(HASL-150) CFSTI: $3.00

Pulse height spectra obtained in the field using a large NaI(Tl) crystal can be analyzed for total environmental γ-ray dose rates, as well as individual dose rate contributions from K^{40}, the U^{238} series, the Th^{232} series, and the principal γ-ray emitting fission products. The calibration of a 5-in. by 3-in. detector is described in detail, and the applicability and limitations of the spectral analysis methods are examined. Several problems associated with field measurements are discussed, in particular the effects of radon migration from the soil, soil moisture, and natural fallout. Evidence presented demonstrates the validity and utility of dosimetric and related information obtained from field spectra analyzed by these methods. Author

N65-22930# United Electrodynamics, Inc., Pasadena, Calif.
EVALUATION OF THE MULTIPLE ARRAY PROCESSOR IN DETECTING P-WAVE MOTION AT THE T.F.S.O. Special Report No. 14
Edward W. Moore 4 Aug. 1964 9 p
(Contract AF 33(657)-7747; Proj. Vela)
(AD-609533)

The measured isotropic processor (MIP) detected a lower number of arrivals than Sum B_2, probably because it enhances high frequency noise at any single seismometer and because

of its lower response to signals with periods greater than 1.0 seconds. The wave form of a seismic signal is changed to some extent by MIP,.but direction of first motion appears the same as for Z-1 and Sum B_2. This may be caused by background noise on one or more seismometers. Examination of the records indicates that MIP, used with individual seismometers and/or a high gain filtered summation trace, is useful as an analysis aid, but possibly due to phase shift, or period of the first P arrival, the time delay appears to vary from 0.8 to 1.2 seconds, so timing of events is not being done from this trace. Visual evaluation of signal-to-noise ratios on MIP, Z–1, Sum B_1, and Sum B_2 shows there is generally an enhancement of signal-to-noise ratio by MIP relative to Z–1, Sum B_1 and Sum B_2, but high frequency noise on a single seismometer causes much more noise on MIP than on Sums B_1 and B_2. Author

N65-22934# Tonto Forest Seismological Observatory, Payson, Ariz.
EVALUATION OF B AND D SUMMATION TRACES AT THE TONTO FOREST SEISMOLOGICAL OBSERVATORY Special Report No. 13
R. W. Davis 3 Aug. 1964 6 p ref
(Contract AF 33(657)-7747)
(AD-609531)

Summations B and B_1 appear to be nearly identical in quality of signal reception to summations D and D_1 at the gains used. Summation D_2 has a more prominent high frequency background than summation B_2. This reduces its reception quality very slightly on low level events. The increase in high frequency background due to increased gains on sums B_1 and D_1, and particularly on sums B_2 and D_2 decreases the probability of "ip" starts. This is to be expected from past analytic experience. Author

N65-22956# St. Louis Univ., Mo. Graduate School
SOURCE REGION OF AIR IN VICINITY OF SQUALL LINE FORMATION. A DYNAMIC ANALYSIS USING POTENTIAL VORTICITY AND ISENTROPIC TRAJECTORIES
Rufus Daniel Mc Collum (M.S. Thesis) 1965 65 p refs
(Contract AF 33(608)-1115)
(AD-611785)

The origin of air in the vicinity of a squall line that formed at 0600 G.M.T. on November 16, 1960 was investigated in this study. The air was identified by values of potential vorticity and the conservative nature of this property was studied. High values of potential vorticity existed in the stratosphere while much smaller ones were typical of the troposphere. The source region of this air was determined by 12-hour air parcel trajectories. This study was conducted on a surface of constant potential temperature (isentropic surface) that sloped from the lower stratosphere over 16000 feet into the troposphere. The potential temperature (0) surface equal to 315° K was used throughout this study. TAB

N65-22986# Joint Publications Research Service, Washington, D. C.
ELECTROMAGNETIC FIELD IN THE WAVE ZONE OF A HORIZONTAL LOW-FREQUENCY ELECTRICAL DIPOLE FOR A THREE-LAYER MEDIUM
V. I. Andreyev 20 Apr. 1965 10 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 11, Nov. 1965 p 148–153
(JPRS-29676; TT-65-30781) CFSTI: $1.00

In a study of low-frequency modification of electrical prospecting, asymptotic equations are derived for determining various components of the electromagnetic field of a horizontal low-frequency electrical dipole situated in the first layer of a three-layer medium. The study is limited to the wave zone of the dipole, where the distance from the source is greater than the wavelength in the layer. The two cases considered are where the conductivities of the layers are finite and nonzero, and where the conductivity is zero for the second layer and nonzero and finite for the others. The layers are plane homogeneous and electromagnetically isotropic, and their electromagnetic characteristics are considered to be independent of time and electromagnetic field. Interrelationships among the parameters in the equations are studied, and conclusions are drawn about field components. J.M.D.

N65-23006# RAND Corp., Santa Monica, Calif.
TRANSMISSION OF MICROPULSATIONS THROUGH THE LOWER IONOSPHERE
Carl Greifinger and Phyllis Greifinger Feb. 1965 47 p refs
(RM-4388; AD-610954)

This report on the detection of high-altitude nuclear explosions is concerned with the low-frequency hydromagnetic waves which are generated by such explosions, and which are detected by ground-current measurements at worldwide locations. Attention is directed to the response of the ionosphere to such low-frequency hydromagnetic disturbances. The purpose is to separate the effects of the medium from those of the source on the transmitted disturbance. TAB

N65-23008# Oak Ridge National Lab., Tenn. Directors Div.
DYNAMICS OF CYLINDRICAL ELECTROMAGNETIC UNIVERSES
M. A. Melvin (Florida State Univ.) Apr. 1965 43 p refs
(Contract W-7405-ENG-26)
(ORNL-3758) CFSTI: $2.00

The general time dependent equations for electromagnetic-gravitational fields in the case of cylindrical symmetry are discussed, and certain conclusions drawn. Solutions as functions of radius and time are found for the two gravitational potential fields and the electromagnetic field which appear when a magnetic universe is subjected to a radial perturbation. It is shown that the magnetic universe is stable (oscillatory) under such perturbations; i.e., all admissible frequencies are real. The converse is also true: All real frequencies are admissible. Every solution is a superposition of proper modes of which there are two types, a g-type and an h-type. The g-type modes may be identified roughly as dominantly gravitational, since in them gravitational perturbations dominate over electromagnetic both at small and large distances; the h-type may be identified as locally electromagnetic, since in these modes, near the axis, the electric and magnetic perturbations dominate over the gravitational perturbations. The radial dependence of each of the mode types for the various fields is expressed linearly, with radius-dependent coefficients, in terms of Bessel coefficients of order zero and one, respectively. The manner in which an initial perturbation is shaken off is analyzed, and causality is verified. The relevance of the analysis to the understanding of gravitational collapse is discussed. It is suggested that extended magnetic fields may play a role in retarding and finally in halting gravitational collapse of material systems. Author

N65-23066*# New Hampshire Univ., Durham. Dept. of Physics
THE INTERPLANETARY MAGNETIC FIELD AND POLAR MAGNETIC DISTURBANCES
D. H. Fairfield and L. J. Cahill, Jr. [1964] 32 p refs
(Grant NsG-624)
(NASA-CR-62576) CFSTI: HC $2.00/MF $0.50

The Explorer 12 measurements of the magnetic field outside the magnetosphere are compared with ground magnetograms from Arctic observatories. Results indicate that an exterior field with a southerly component tends to be associated with ground disturbance while a northward field is associated with quiet conditions. Examples are presented showing how a north to south field direction change accompanies an increase in ground activity, and also how south to north changes may produce quiet intervals between substorms. Results are discussed in terms of breaking and reconnection of the interplanetary field to the dipole field as the solar wind carries the variously directed interplanetary fields past the earth. Author

N65-23087# Emmanuel Coll., Boston, Mass. Research Language Center

IS IT POSSIBLE TO REMOVE THE ICE COVER OF THE NORTHERN ARCTIC OCEAN? [MOZHNO LI UNICHTOZHIT'LEDOVYI POKROV SEVERNOGO LEDOVITOGO OKEANA]

L. G. Toporkov Bedford, Mass., AFCRL, Apr. 1964 15 p refs Transl. into ENGLISH from Priroda (Moscow), no. 11 p 93–97

(Contract AF 19(628)-3869)

(E-T-R-64-23; AD-611038)

The feasibility of a plan for the removal of the ice cover of the Northern Arctic Ocean is discussed. The plan involves the construction of a dam across the Bering Straits and transferring 150000 cubic km/year of water from the Northern Arctic Ocean into the Pacific Ocean and an inflow of the Atlantic Ocean into the Northern Arctic Ocean. TAB

N65-23089# Emmanuel Coll., Boston, Mass. Research Language Center

THE ISOSTATIC STATE OF ANTARCTICA AND DEFLECTION OF THE EARTH'S CRUST UNDER THE WEIGHT OF CONTINENTAL GLACIATION [IZOSTATICHESKOE SOSTOIANIE ANTARKTIDY I PROGIBANIE KORY POD NAGRUZKOI MATERIKOVYKH OLEDENENII]

S. A. Ushakov Bedford, Mass., AFCRL, May 1964 37 p Transl. into ENGLISH from the publ. "Rezul'taty Issledovanii po Programme MGG, Gravimetriia, No. 4" Moscow, 1963 p 44–60

(Contract AF 19(628)-3869)

(E-T-R-64-30; AD-611115)

A review of all available Soviet and American data indicates that Antarctica is, despite the excess ice load, basically in a state of isostatic equilibrium although the major geological structures are reflected in regional Faia anomalies. Of all the regions of Antarctica in which gravitational studies have been made, the Faia anomalies differ considerably from the isostatic condition only in the Gamburtsev Mountains region, and the average magnitude of Faia anomalies in the entire area of western Antarctica is close to zero. Seismic and gravimetric data reviewed indicate that the isostatic equilibrium occurred as a result of the earth's crust subsiding under the weight of the glacial load. Data on the well-studied deflection of the earth's crust under the weight of ancient continental glaciations of Canada and Fennoscandinavia are presented in support of the conclusion that all major continental glaciations taking place in any epoch whatever have caused deflection of the earth's crust in the platformed regions. Finally, a general review of the role of isostacy in geotectonics is presented. M.P.G.

N65-23093# Emmanuel Coll., Boston, Mass. Research Language Center

THE GEODETIC METHOD OF STUDYING RECENT MOVEMENTS OF THE CRUST AND RESULTS OF ITS APPLICATION [O GEODEZICHESKOM METODE IZUCHENIIA SOVREMENNYKH DVIZHENII ZEMNOI KORY I REZUL'TATAKH EGO PRIMENENIIA]

M. I. Siniagina Bedford, Mass., AFCRL, Sep. 1964 22 p refs Transl. into ENGLISH from the publ. "Rezul'taty Issledovanii po Mezhdunarodnym Geofizicheskim Proektam, no. 1" USSR, 1963 p 25–32

(Contract AF 19(628)-3869)

(E-T-R-64-31; AD-611114)

The study of the recent vertical movements of the earth's crust, originated by different causes, is a very serious problem. This report describes the methods applied in different countries for the compilation of maps, of recent vertical movements velocities on considerable territories. Much attention is given to consideration of the principles of the choice of reference surface for the compilation of the maps. The research carried out proved that the most applicable reference surface in the compilation of the maps of recent vertical velocities is the surface mean level of the World Ocean, which is assumed to be constant in time. Author

N65-23180# Emmanuel Coll., Boston, Mass. Research Language Center

PRELIMINARY RESEARCH OF CONVECTIVE HEAT TRANSFER IN THE LOWER ATMOSPHERIC LAYER

Ming-Yü Chou Bedford, Mass., AFCRL, Jan. 1965 18 p refs Transl. into ENGLISH from Acta. Met. Sinica (Peking), v. 33, no. 3, 1963 p 290–296

(Contract AF 19(628)-3869)

(E-T-CH-64-26; AD-611279)

Based on a analysis of the interaction between convective heat transfer and atmospheric stratification, a model of convective heat transfer, and numerical computation is given. The results of the computation show that the interaction between heat transfer and atmospheric stratification plays an important role in heat transfer. Heat flux is much greater during unstable stratification than during stable stratification. As a consequence of the vertical transfer of heat flux, atmospheric stratification clearly changes in the initial stage, while in the final stage, it approximates neutral stratification. Author

N65-23220# Navy Electronics Lab., San Diego, Calif.

SEA-SURFACE TEMPERATURE ESTIMATION. AN EMPIRICAL STUDY OF THE EFFECT OF MISSING DATA ON REGRESSION AND AUTOCORRELATION ANALYSES OF TIME SERIES OF DATA

C. J. Van Vliet 5 Jan. 1965 35 p refs

(NEL-1256; AD-458583)

Many time series of sea-surface temperatures feature random missing data or long periods of missing data. Methods are presented that enable one to correct for the effects of the missing data in computations of regression and autocorrelation coefficients. Author

N65-23243# Joint Publications Research Service, Washington, D. C.

HUNGARIAN RESEARCH ON THE PHYSICS OF THE ATMOSPHERE

Desi Frigyes 11 May 1965 6 p Transl. into ENGLISH from Idojaras (Budapest), no. 5, Sep.–Oct. 1965 p 287–291 Presented at the Sci. Symp. of the Geophys. Inst. of the Bulgarian Acad. of Sci., Sofia, 12–16 Oct. 1964

(JPRS-30006; TT-65-30954) CFSTI: $1.00

Research was reported in the following areas: *Cloud Physics*—concentration and magnitude distribution of chlorate sulphate and calcium particles pointed out the importance of nucleus size in separating condensation nuclei; investigations of ice crystal growth contradicted the temperature limits pertaining to the individual crystal shapes, as well as the evaluation of the role played by the Bergeron process; the microstructure of radiating fog was found to contain a particle concentration of 10^{-1} parts per cm^3 and a distribution mode of $r = 5$; and measurements of the concentration of medium- and large-size ions in atmospheric particles as well as electric space measurements. *Ionospheric research*—the increase of the limiting frequency and altitude of the F_2 layer in connection with solar activity; classification of the ionospheric storms over Budapest; and the effects of the solar eclipse of February 15, 1961 on the ionosphere. *Turbulence Research*—summary of literature on turbulence in the upper atmosphere; and investigations of the mixing processes in near-ground layers. G.G.

N65-23271# Dartmouth Coll., Hanover, N. H. Civil Engineering Dept.
FLEXURAL PROPERTIES OF SNOW AND SNOW-ICE
S. Russell Stearns Hanover, N. H., Army Cold Reg. Res. and Eng. Lab., Oct. 1964 19 p refs
(Contract DA-11-190-ENG-32)
(CRREL-SR-59; AD-610143)

One testing objective was to determine if small, select samples of natural snow ice, tested in bending, would provide consistent and higher values for the flexural strength and modulus of elasticity. Another objective was to investigate the surface bearing properties of snow-ice layers, formed during winter on lakes or rivers, which are often separated from clear ice by an interlayer of slush or water. Samples of this type of snow ice were obtained from Post Pond in New Hampshire. The other forms of ice-cap snow, natural snow (top and 15-ft depth), and high-density snow were tested during two summers on the Greenland ice cap. Densities in all cases were obtained by cutting a cube of snow from the sample beam adjacent to the break. Dense snow-ice at +5° had high flexural strength (avg 347.5 psi) and a high modulus of elasticity (avg 6.08×10^5 psi), probably the result of a large, interlocking crystal structure. The apparent relationship between modulus of elasticity and density of snow ice is affected by the rate of loading and temperature. There appears to be a relationship between density and flexural strength for snow, snow ice, and high-density snow in the natural undisturbed state; but processing, including snow compaction, lowers the tensile strength at early ages. The formulas used in computations are given, and test results are tabulated and summarized. Author

N65-23316# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics
OBSERVATIONS OF LIGHT SCATTERING IN SEA WATER
Athelstan Frederick Spilhaus, Jr. (Ph.D. Thesis) Feb. 1965 246 p refs
(Contract Nonr-1841(74))
(AD-610126)

Combination of theoretical curves of the volume scattering function for several different monodisperse systems of Mie scatterers shows that, in a polydisperse system, the total scattering coefficient is determined by scattering at small angles to the direction of the incident beam; as particle sizes increase, rise in the volume scattering function at small angles increases. A method was devised to study shape of the volume scattering function for various types of sea water. Samples from surface waters and at depths up to 2000 meters were taken between Woods Hole and 26° N, 63° W. Water in the Sargasso Sea was found to have a significantly different scattering function from that of the slope and coastal waters. In a thermal front south of Bermuda the water along one isotherm was different from the average of that on either side of it. The total scattering coefficient showed banding on the continental shelf. The thermohaline front that exists on the edge of the shelf in winter is marked by a threefold change in the magnitude of the scattering. Using a laser as light source, forward scattering measurements were made to obtain relative total scattering. A continuous track was made between Woods Hole and Port Lewis, Mauritius. In the proximity of land twofold fluctuations of scattering in a range approximately three times higher than the nearly constant values found in mid-Atlantic were observed. Some fluctuations of the open sea values in the Atlantic were associated with thermal changes. Author

N65-23317# Raytheon Co., Alexandria, Va. Autometric Facility
EXPANDED STUDY OF THE APPLICABILITY OF MULTIFACTOR COMPUTER PROGRAMS TO TERRAIN ANALYSIS Final Report
Jay H. Simons, James C. Maxwell, John Imbrie, and Vince Manson 15 Nov. 1964 234 p refs
(Contract Nonr-4523(00))
(AD-609401)

The objective of this study was to increase the scope of experimental testing to draw conclusions of more universal applicability to terrain analysis. Geomorphic objectives were designed to (1) increase the areal extent of the test cases; (2) include areas significantly different topographically and geomorphically, from those previously analyzed; (3) engage in experimental testing using a basic set of nonredundant variables; (4) engage in experimental testing of new variables relating to the surface geometry; and (5) explore the feasibility of including nontopographic variables. Among the results of this study was the compilation of a new set of terrain data, which, along with the data from the previous study, provide a valuable resource for testing any quantitative geomorphic terrain system now available; the conclusion that there is not, at present, any single quantitative terrain analysis system that lends itself to universal application; that there is a real need for the development of a quantitative terrain analysis which can be applied generally, and which can utilize automatic data acquisition systems. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-22210# Electro-Optical Systems, Inc., Pasadena, Calif.
OPTICAL SURVEILLANCE COMPONENT TECHNIQUES Final Report, 22 Oct. 1962–22 Nov. 1963
Paul C. Fletcher, Mani L. Bhaumik, David L. Weisman, Burt L. Cooke, David L. Fridge et al. Griffiss AFB, N.Y., RADC, Jan. 1965 173 p refs
(Contract AF 30(602)-2914)
(RADC-TDR-63-557; EOS-3460-Final; AD-612359)

The techniques and components necessary for the implementation of an optical Doppler surveillance system are discussed. Specifically, the requirements of an optical transmitter are set down. Efforts to use chelates to achieve both a gaseous narrow band oscillator and a high power amplifier are described. The description of lasering action in several chelates of europium is included with the theory of why some chelates lase and others do not. The incorporation of an oscillator and an amplifier into a transmitter is described using Nd:$CaWO_4$ as the oscillator and Nd glass as the amplifier. Gains of 10 dB were achieved in a single-pass amplifier, which is 8 inches long and pumped with 6000 joules. The problems of isolation of the oscillator and amplifier are discussed, and a breadboard model of a Faraday isolator using flint glass was built with greater than 30-dB isolation and less than 1-dB insertion loss. The problems of optical heterodyne receiving are discussed. Measurements on mono-moding of lasers, stability and stabilizing of lasers, modulation of lasers by end reflectors variation, for both amplitude and frequency modulation are discussed. A description of a possible wideband heterodyne receiver is presented. Measurements are made using a 1 to 2 Mc/second Kerr cell amplitude modulator as a target simulator. Author

N65-22235# Naval Ordnance Lab., Corona, Calif. Research Dept.
OPERATION OF THE NOLC X-BAND RADIOMETER
M. C. Hoover, Jr. 1 Dec. 1964 49 p refs
(NOLC-613; AD-611425)

This report describes the NOLC X-band mapping radiometer. All phases of the operation are discussed, and the methods used for calibration of the radiometer calibrate-temperature step are explained. An analysis of the system losses is presented, and the effect of these losses on the radiometer measurements is described. Author

N65-22278 Army Electronics Labs., Fort Monmouth, N. J.
THE REALIZATION OF ACTIVE SEISMIC SYSTEMS AND THEIR PRACTICAL APPLICATIONS
Kurt Ikrath and W. Schneider *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 1–14 ref (See N65-22275 12-34)

Seismic transducers with an artificial elastic transmission line section that acts as a resonant matching transformer between the low impedance of the electrodynamic speaker drive systems and the high mechanical impedances of seismic propagation media are described. These transducers, together with the ancillary devices and circuits described, proved valuable as measurement instruments in the investigation of elastic-wave propagation in sand–gravel soil and lake ice. Seismic communication at 80-cps carrier and 2-cps bandwidth was achieved over a distance of up to 0.5 km in soil covered, partially wooded terrain with less than 14 watts of 80-cps transducer power. Also, it was found that a minimum of 10 mW of 80-cps transducer drive power was necessary for the detection of the radiated seismic signal at a distance of about 100 meters on sand–gravel soil. The transducer transmitter conversion ratio was found to be 0.64 mm sec^{-1} $W^{-1/2}$ with a peak impedance of 6.2 ohms. The receiver conversion ratio was 0.1 to 0.15 open-circuit volts/mm/sec ground surface displacement velocity. E.E.B.

N65-22279 Harry Diamond Labs., Washington, D. C.
A NEW GRAVITY METER
Henry P. Kalmus *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 41–54 (See N65-22275 12-34)

A new method for the determination of gravity is described which is rapid and easy to apply and still has a sensitivity of at least 1 mgal. The method should be applicable at sea and in aircraft since the output of the instrument is obtained as an ac voltage, the average of which can be obtained by integration. The acceleration due to gravity is continually compared with centripetal acceleration by means of an ac-null method whereby a single transducer is exposed to equal pressure amplitudes from gravity and from the centripetal acceleration. In this way, the transducer characteristics are rendered noncritical. Further, since the new method is based on the comparison of two ac-voltages, their waveforms should be free from distortion. If all elements of the apparatus are rigid, this is the case. However, bending of the arms will occur in the practical case causing phase-modulation of the angular velocity. The equations of motion are established, an error analysis is performed, and the apparatus design discussed. E.E.B.

N65-22287 Aberdeen Proving Ground, Md. Ballistic Research Labs.
AN OPTICAL SYSTEM FOR MEASURING THE ANGULAR MOTION OF THE GUN TUBE AND THE PROJECTILE IN THE BORE
Stanley S. Lentz *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 153–167 refs (See N65-22275 12-34)

An apparatus is described which makes it possible to observe the very small angular motions of a projectile in the gun tube. An analysis of this motion, combined with that of the other experimental results, provides insight as to forces and constraints acting on the projectile. The apparatus is essentially an optical system which has a carbon arc light source and a condensing lens which focuses the light on a pinhole located at the focal point of the off-axis paraboloidal mirror. A rotating perforated disc, just forward of the pinhole, interrupts the light to establish time marks on the trace and to furnish orientation points for correlating the various records. Details of the apparatus and its components are given for the light source, mirrors, recording film, and shutters. Also, test procedures, measurements, and data reduction are discussed. Further, a diagram of the system is included. E.E.B.

N65-22318# Westinghouse Electric Corp., Pittsburgh, Pa.
VAPOR DEPOSITED THIN FILM PIEZOELECTRIC TRANSDUCERS Scientific Report No. 1
John de Klerk and Eugene F. Kelly Bedford, Mass., AFCRL Feb. 1965 25 p refs *Its* Rept.-64-9F5-108-P1
(Contract AF 19(628)-4372)
(AFCRL-65-73; AD-613540)

A new vapor-deposition technique has been developed for the production of insulating thin-film CdS and ZnS piezoelectric transducers. These high efficiency transducers have been used to generate either shear or compressional waves in dielectric materials at frequencies in the gigacycle range. The thickness, which is measured by means of a quartz crystal microbalance, is controlled to produce films which operate at their fundamental resonance. The mode of the generated waves is determined by the orientation of the driving electric field with respect to the crystal axes of the film transducer. Author

N65-22341# Technology, Inc., Dayton, Ohio.
AIRBORNE MAGNETIC TAPE RECORDER FOR GRAVITY MEASUREMENTS Final Report, 1 Feb. 1963–30 Nov. 1964
Cyril G. Peckham and Charles D. Conner Bedford, Mass., AFCRL Dec. 1964 52 p ref
(Contract AF 19(628)-2755)
(AFCRL-65-61; AD-613278)

This report treats of the development of an airborne recorder to transcribe onto magnetic tape in digital form the parameters needed to compute the gravitational field encountered by an aircraft at any point above the earth's surface.

The number of bits allocated for the recording of each parameter was conditioned by the resolution required for optimum accuracy as well as by the range of values. To determine the accuracy, researchers investigated the current sensing and recording devices employed and reviewed the previous efforts to extract, process, and evaluate previously acquired data. Through this study which included the applicability of different smoothing techniques and determination of the effects of measurement errors on the Eotvos effect, information to guide the computer processing of the data as well as to define the parameters was developed. Based upon a complete design, a prototype recorder was fabricated. Including provisions for recording all parameters. The prototype recorder incorporates the means to digitize five of the more difficult parameters to process manually. Author

N65-22378# Measurement Analysis Corp., Los Angeles, Calif.
TRANSDUCERS FOR SONIC FATIGUE MEASUREMENTS
Ronald D. Kelly Wright-Patterson AFB, Ohio, Res. and Technol. Div., Feb. 1965 120 p refs
(Contract AF 33(615)-1314)
(MAC-403-01; AFFDL-TR-64-171; AD-613946)

This report discusses the machine errors of transducer systems used for the measurement of dynamic input and response data during sonic fatigue testing. The specific types of transducers covered are accelerometers, microphones, and strain gages. The basic operating principles, intrinsic inaccuracies, environmentally related inaccuracies, and usage inaccuracies are described. These inaccuracies are broken down into errors occurring in the transducer, cabling, and signal conditioner, as well as those due to system operation. In addition, methods for minimizing these errors are given. Author

N65-22384# Naval Ordnance Lab., White Oak, Md.
A NEW SENSING TECHNIQUE APPLIED TO AUTOMATIC POSITION CONTROL IN CERTAIN ABLATION EXPERIMENTS
W. J. Mc Lean Feb. 1965 45 p refs
(NOLTR-64-202; AD-612505)

A new sensing technique was devised that can be applied to automatic adjustment of the position of the ablating end of an NOL α-rod specimen or organic material which is being consumed endwise in a hot, corrosive atmosphere. The sensor is an ion collector which is located close to the edge of the ablating end of the rod and which is just barely immersed in some of the hot, weakly ionized gases near this end. The ion density in the vicinity of the collector depends strongly on how closely the ablating end of the rod approaches it. Ions neutralized on the collector give rise to a small current that can be used as a signal for control purposes, such as keeping the ablating region in a relatively fixed position in space so that the rod can be moved into the hot corrosives of the material of the rod. Read-out of position of the cold end of the rod with time gives a measure of the ablation rate. Author

N65-22391# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
TRANSDUCER TILT IN WIDTH-SHEAR MODE DELAY LINES
Abraham Rand and Eugene J. Chabak Jun. 1964 19 p
(ECOM-2391; AD-613647)

Misalinement of the ferroelectric ceramic transducers in a width-shear mode ultrasonic delay line is a recognized source of signal attenuation. An evaluation is made of its effect on a 200-μsec line operating at a center frequency of 10 Mc. Using an aluminum transmission line and controlled localized heating to produce controllable amounts of misalinement, experimental values were obtained. A simplified analysis provides a theoretical curve which agrees with the experimental values and, in particular, matches well for the smaller degree of misalinement which is of practical interest. Author

N65-22430# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF CALIBRATING ACCELERATION SENSING ELEMENTS WORKING IN PULSED CONDITION
K. Ye. Bogoslovskiy, M. M. Korenchenko et al 18 Jan. 1964 5 p Transl. into ENGLISH from Soviet Patent No. 159668 (Appl. No. 777803/26-10, May 9, 1962) p 1-2
(FTD-TT-64-868/1+2; AD-611074) CFSTI: $1.00

According to the proposed method, the acceleration sensing element is placed in the shock tube in a slip ring (piston) and by the magnitude of its displacement from the effect of gas dynamic pulsed load is determined the sensitivity of the sensing element. The device is made in the form of a tube consisting of a high pressure chamber, and a low pressure chamber, separated by a diaphragm. In the low pressure chamber the piston is placed with the acceleration sensing element. Upon attainment of a given pressure in the high pressure chamber, the diaphragm breaks and the shock wave, as it propagates over the low pressure chamber, activates the piston. The displacement magnitude of the piston is recorded by a photoelectric or an inductive sensing element connected into the circuit of the recording instrument. TAB

N65-22433# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF UNAMBIGUOUS MEASURING THE DISTANCE BETWEEN AN AIRCRAFT AND TWO OR MORE GROUND RESPONDER-STATIONS AND THE DEVICE FOR REALIZATION OF THIS METHOD
I. L. Gill 11 Feb. 1965 15 p Transl. from Russian Patent no. 160838 (Appl. no. 766622/40-23, Feb. 27, 1962) 6 p
(FTD-TT-64-942/1+2; AD-611530)

In the aircraft multichannel receiver, the signals from the ground transponders are divided by one heterodyne signal from the generator of an uhf transmitter. The different frequency pulses separated from the output of detectors of each receiver channel are fed to one pulse mixer to activate the CRT scanner and the difference in frequency of low frequency sinusoidal oscillations separated also from the output of detectors are transformed into pulses and are fed together with the output pulses of the mixer to another pulse mixer to obtain on CRT screen an image of the measuring brightness markers. Indications from the screen are continuously photographed on a moving photo film of photo recorder. The total distance is determined by the disruption in curve recording of continuously changing distances, forming at the moment of switching over the oscillation frequencies, modulating the carrier frequencies of signals coming from aircraft-station and responders. TAB

N65-22465# Giannini Controls Corp., Duarte, Calif.
BRUSHLESS PRECISION POTENTIOMETER Interim Development Report, 5 Nov. 1964-5 Feb. 1965
17 Mar. 1965 37 p refs
(Contract NObsr-91175)
(ER-8645-3; AD-613213)

A program designed for the development of a vacuum evaporated thin-film brushless precision potentiometer whose life, wear, noise, and contact resistance characteristics are independent of applied torque is reported. An evaluation of substrate material, photoconductor material, sensitizing techniques, resistive strip materials, and fabrication techniques

is presented as well as a study of the compatibility between materials and techniques. Results of studies on encapsulation, contact resistance, deposition of photoconductors, resistance control, material compatibility, light source, design and production, and disc layout and mask fabrication, are presented. Also included are results from an evaluation of several specimen photopots and the preliminary assembly layout. S.C.W.

N65-22481# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering
STUDY OF METHODS OF IMPLEMENTING POYNTING VECTOR MEASUREMENTS Final Report, 1 Jul. 1962–31 Dec. 1964
W. W. Cowles, N. Farhat, and K. S. Foo. 30 Dec. 1964 111 p refs
(Contract NBy-32219)
(Rept.-65-16; AD-458560)

Special instrumentation for implementing a Poynting sensor for coherent measurement of the Poynting vector is discussed. Described are instruments for amplification of the output signals, calibration of the amplitudes, and for receiving input signals. Also included in the report are a theoretical justification for the operation of the Poynting sensor; a summary of work on the magnitude of the field components and the sensor output as a function of distance from the source; a complete derivation of work on the directional properties of the Poynting sensor, and results of a study on Poynting sensor response to broadband signals. S.C.W.

N65-22572 Air Force Cambridge Research Labs., Bedford, Mass.
GEODETIC STELLAR CAMERA SYSTEMS
Paul B. Swenson *In* White Sands Missile Range 1963 Tech. Papers Jul. 1964 p 9–12 (See N65-22570 12-13)

The ballistic camera, photoflash cartridge, intercontinental range missiles, flare triangulation, geodetic stellar camera, rocketborne flare triangulation, and the geodetic satellite are discussed. The ballistic camera uses a 300-mm lens with a 33° field of view. Two shorter focal length lenses have also been used. Resultant data are accurate to one part in 10000. Also, a means of synchronizing the shutters of all these cameras on the range to an accuracy of about 0.1 millisec was developed which insures simultaneous fixes on the missile for greater accuracy and redundancy. The photoflash device weighs only a few ounces and during its burning time of less than 20 millisec produces up to 20 million candle power. Its simplicity and weight allow it to be carried by the smallest of rockets and its light output allows it to be photographed at ranges of thousands of miles. E.E.B.

N65-22578 White Sands Missile Range, N. Mex.
WSMR BC-4 BALLISTIC INSTRUMENTATION SYSTEM
H. R. Shoppach *In its* 1963 Tech. Papers Jul. 1964 p 59–66 (See N65-22570 12-13)

The missile range instrumentation system is described for the optical recorder and theodolite, synchronization system, facilities, camera skyscreen and optical director systems, and mercury pool orientation system. Personnel development and future planning are also discussed. A block diagram of the synchronization system functions and a map of the missile range indicating disposition of the eight camera systems, facilities, and planned facilities are included. The ballistic camera technology training program covers astronomy and meteorology; ballistic camera operational and data reduction theory; operational practice; plate processing and star identification; timing measurement systems; and installation, utilization, and field operations. The ballistic camera synchronization and control system operation and maintenance training program includes courses on basic control functions; system operations; practical applications; and tactical operation and field maintenance. E.E.B.

N65-22602*# National Aeronautics and Space Administration, Washington, D. C.
SOLAR TRACKING HEAD [SOLNECHNAYA SLEDYASHCHAYA GOLOVKA]
I. G. Vasil'yev and A. I. Shapov 3 Jun. 1962 10 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), v. 11, 1961 p 87–93
(NASA-TT-F-8236) CFSTI: HC $1.00/MF $0.50

Described is a tracking head designed for a joint operation with the diffraction spectrometer for the measurement of solar radiation in the far ultraviolet. It directs the mirror-reflected beam of soler rays into the spectrometer's slit at ±10 angular minutes for different positions of the spectrometer. The coupling of the spectrometer with the tracking head allows the tracking of the sun at 120° in the plane normal to the longitudinal axis and at 110° in the plane perpendicular to the transverse axis. Tuning of the tracking head elements was effected according to the position of the Sun's picture on the autocollimator's coordinate grid. Diagrams of the tracking head and circuit are presented. G.G.

N65-22608*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FEASIBILITY OF USING A THROTTLING CALORIMETER FOR LIQUID-METAL VAPOR QUALITY MEASUREMENTS
Ted W. Nyland Washington, NASA, May 1965 17 p refs
(NASA-TN-D-2802) CFSTI: HC $1.00/MF $0.50

The use of a throttling calorimeter for vapor-quality measurements in liquid-metal systems is discussed. The throttling calorimeter is limited to measurements in the quality range 0.91 to 1.00 for potassium based on stream temperatures between 1600° and 2200° F and expansion pressures from 1 to 10 pounds per square inch absolute. Pressure and temperature measurement errors introduce a maximum uncertainty of ±0.005 based on the assumption of the availability of accurate property values, while heat losses are estimated to produce uncertainties of less than ±0.005. The problem of sampling two-phase streams is discussed, and limits are placed on the degree of control required for the sampling system. These results are typical of those that would be expected for other liquid metals. Author

N65-22624*# Consultants and Designers, Inc., Arlington, Va.
EXPERIMENTAL APPLICATION OF AN ELECTROSTATIC ANALYZER ABOARD "COSMOS-12" [OPYT PRIMENENIYA ELEKTROSTATICHESKOGO ANALIZATORA NA SPUTNIKE "KOSMOS-12"]
V. V. Mel'nikov, I. A. Savenko, B. I. Savin, and P. I. Shavrin 29 Apr. 1965 11 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 148–154
(Contract NAS5-3760)
(NASA-TT-F-9672; ST-PF-EI-10324) CFSTI: HC $1.00/MF $0.50

This paper describes the spherical electrostatic analyzer installed aboard the satellites Cosmos-12 and Cosmos-15, and applied for the investigations of fluxes of electrons and positive ions with energy E = 1 keV. The analyzer had the following characteristics: pass-band width $\Delta E/E \sim 30\%$, sensitivity threshold in the assumption of isotropy of fluxes $\sim 6 \cdot 10^6$ part./cm^2·sec keV. The results of measurements during the

flight of Cosmos-12 are presented. It is found that the existing fluxes of electrons and ions with E = 1 keV on the night side of the earth do not usually exceed the analyzer's sensitivity threshold. Cases were noted to the south of New Zealand of intensity increase of mainly electrons with energy E = 0.5 to 1 keV. Appearance of electrons and ions with energy E = 1 keV was registered above the Pacific Ocean. Author

N65-22704# University of Southern Calif., Los Angeles. Graduate School

A SURVEY OF DOCUMENTARY AND TECHNICAL CINE PHOTOGRAPHY AT THE AIR FORCE FLIGHT TEST CENTER

Charles David Pellow (M.A. Thesis) Jan. 1965 187 p refs (AD-612154)

The purpose of this thesis was: (1) to present the problems encountered in obtaining cine photography in the testing of aerospace vehicles and related equipment at the AFFTC, and the attempts made to resolve these problems by military and civilian photographic experts; (2) to survey techniques used by cine photographers in obtaining documentary, engineering surveillance, and technical (scientific) cine photography at the AFFTC; (3) to survey equipment used by cine photographers at the AFFTC; and (4) to determine the effectiveness of cine photography in saving time, money, and lives in the flight test program. TAB

N65-22719 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN ELECTROSTATIC FLUXMETER DESIGNED FOR MEASUREMENT IN THE UPPER LAYERS OF THE ATMOSPHERE

G. L. Gdalevich, I. M. Imyanitov, and Ya. M. Shvarts *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 161–174 refs (See N65-22713 12-30)

A noise-stable instrument for measuring electrostatic field strengths in the upper layers of the atmosphere is described. The block diagram and schematic electrical diagram of the instrument are presented. The design of the sensor is described. The instrument's range of measurement is ± 2 to 3 V cm^{-1} and its measurement error is ± 0.25 V cm^{-1} $\pm 0.25E_{izm}$. Author

N65-22727 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A TRANSISTORIZED ELECTROMETRIC AMPLIFIER FOR MEASURING WEAK CURRENT FROM CHARGED-PARTICLE DETECTORS

N. N. Goryunov, B. I. Savin, and E. N. Sosnovets *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 282–286 (See N65-22713 12-30)

An amplifier is described in which a capacitor and a relay are used to convert a direct current quantity into voltage pulses whose amplitudes are proportional to the current. This amplifier overcomes the difficulties inherent in the use of transistorized amplifiers, the high value of the uncontrolled collector current and the wide temperature drift of the transistor parameters. Other advantages of this amplifier are the possibility of digital readout of the measured current, compactness, economy, operation under vacuum conditions, and registration of both positive and negative particles. The circuitry is described and a block diagram is given. Eight transistors are used, four as amplification stages and four as part of the pulse-output amplitude-time conversion system. Three electrometric amplifiers of this type were used as a weak-current measuring circuit in the charged particle collector at the output of the electrostatic analyzer carried on Cosmos 12 and 15 satellites. The full dynamic range of the circuit was ~1000 and the largest number of pulses in a series was about 40. The sensitivity threshold of the first amplifier was ~10 mV, which, for T = 120 sec and $C_1 \approx 100 \mu\mu f$, corresponds to a threshold current of $\sim 8 \times 10^{-15}$ amp and an intensity of $6 \times 10^6 / E_0$ particles $cm^{-2} \cdot sec^{-1} \cdot keV^{-1}$ where E_0 is the particle energy to which the analyzer is tuned. M.P.G.

N65-22737 Army Electronics Labs., Fort Monmouth, N. J.

TE_{01}° CROSS-GUIDE TRANSDUCER AND ISOLATOR

John P. Agrios, C. D. Neudorfer, and R. A. Stern *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 57–70 refs (See N65-22732 12-34)

Two designs were developed, one for a $TE_{10}^{\square}$ mode to TE_{01}° mode transducer and the other for a cross-guide isolator for use in a TE_{01}° mode system, with results which have not been attained heretofore. The transducer not only represents a device which has immediate application, but also provides an indispensable tool for the development of TE_{01}° components. A scaled version of this transducer for use at 35 Gc in order to better evaluate the mode purity characteristics of the cross-guide isolator is being attempted. The designing of this isolator with hexagonal ferrite materials offers a method for designing ferrite isolators for use in the TE_{01}° mode systems operating in the millimeter region, which are compact and have good electrical characteristics. Author

N65-22783 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

PLASMA PROBES FOR AURORAL ROCKET RESEARCH

A. G. Mc Namara and L. R. Mc Narry *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 5–7 From Bull. of Radio and Elec. Eng. Div., v. 11, no. 3, Oct. 1961 (See N65-22781 12-31)

General design considerations for rocketborne plasma probes to provide high-resolution measurements of the ionization density, the particle energy spectrum, and their spatial distribution are discussed. The height of maximum auroral luminosity is typically 100 km, and a rocket such as the solid fueled Black Brant reaching a maximum altitude of 200 km will spend approximately 5 min above the 100-km level. Plasma probes of various geometries which will be flown on these rockets are illustrated and discussed. Three of the probes are of the Langmuir type and one is a spherical ion trap with a single screen surrounding the collector. Probe voltages will be telemetered to earth along with tracking signals to define the rocket's position accurately and permit correlation of the rocket data with ground-based observations. M.P.G.

N65-22788 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.

A ROCKET-BORNE ACOUSTIC MICROMETEORITE DETECTOR

R. Wlochowicz *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 32–36 refs From Bull. of Radio and Elec. Eng. Div., v. 13, no. 1, Apr. 1963 (See N65-22781 12-31)

The design of a micrometeorite detector in which a crystal microphone uses the rocket nose cone as the sensing surface is described. Primary impact signals are generated by the microphone and a three-stage narrowband amplifier tuned to the mechanical resonant frequency of the microphone. The signals are processed by two detectors; one, with a short time constant, extracts the impact-induced pulse envelope and the other produces a dc voltage proportional to noise. A gating circuit eliminates multiple counts of a single impact, and impact magnitude data are obtained by multivibrator responses to the signal levels after one and two stages of amplification. An arbitrary but reproducible calibration technique was developed using the impact response signal from a small polystyrene sphere dropped from a height of a few centimeters. Two of these acoustic detector units with different threshold

sensitivities were mounted on opposite sides of a Black Brant rocket, and both units functioned throughout the 6-minute flight test. Preliminary analysis indicates no impact for particles larger than 6×10^{-8} gm. M.P.G.

N65-22820# Aberdeen Proving Ground, Md. Human Engineering Labs.
A SURVEY OF INSTRUMENTATION FOR PRODUCING IMPULSE NOISE
David C. Hodge and Robert B. Soderholm Mar. 1964 13 p refs
(TN-3-64)

The need for a source of impulse noise providing independent control, within specified limits, of peak sound-pressure level, rise time, and duration is discussed. A survey of impulse-noise sources that were used in past studies is presented. Author

N65-22888# Watervliet Arsenal, N. Y. Benét R & E Labs.
THE EFFECTS OF HIGH PRESSURE ON FOIL STRAIN GAGES
R. V. Milligan Nov. 1964 47 p refs
(WVT-6422; AD-611211)

This paper shows the effects of fluid pressures to 140 ksi on four different types of SR-4 foil-type-strain gages. Linear pressure–strain curves were obtained for these gages mounted on flat surfaces of tungsten, steel and aluminum specimens. The inverse slope of the pressure–strain curves is compared with the compressibility constant 1/2 NU/E as calculated from experimentally determined values of E and NU. Experimental results show the percent deviation between the constants to be a function of the material, being greatest for tungsten and least for aluminum. Temperature effects, as a function of the rate of applied pressure, are investigated. The types of gage failures encountered along with photomicrographs showing probable causes are presented. Author

N65-22937# Bollay (E.) Associates, Inc., Goleta, Calif.
INSTRUMENTATION FOR THE DIRECT MEASUREMENT OF FOG DROPLET GROWTH
Robert A. Begun Aug. 1964 135 p refs
(Contract FAA-ARDS-554)
(RD-64-136; AD-608374)

An instrument is in operation that directly measures water droplet growth as a precursor of developmental fog formation. Water droplet sizes of interest range from 0.1μ to 1.0μ, prior to the particles becoming visible to the human eye. Using optical techniques, the instrument measures the transmission of two discrete wavelengths of ultraviolet light over a path length of 125 ft. The atmosphere is not disturbed. As the absolute value of the transmission is not quantitatively measured, the alinement of the unit is not critical. Several cases of development fog were successfully indicated by the instrument several hours before visibility was affected. Author

N65-22940# Naval Research Lab., Washington, D. C.
CALCULATED SPECTRAL RESOLUTION OF PERKIN-ELMER PRISM AND GRATING MONOCHROMATORS
E. D. Palik and James R. Stevenson 8 Dec. 1964 30 p refs
(NRL-6177; AD-609902)

A simple derivation of the spectral resolution of the standard Perkin–Elmer prism and grating monochromators (Models 12-C and 12-G) was carried out. Some attention is given to discussion of the variation of the diffraction pattern width ... the exit slit as a function of the physical width of the entrance slit. Brief mention of power considerations is also made. The resulting formulas were used to calculate spectral slit width curves for 8 different prisms and 26 gratings. The spectral slit width in cm^{-1} is plotted as a function of the frequency in cm^{-1} and wavelength in microns. These detailed graphs allow a determination of spectral slit width from quick inspection. Author

N65-22965# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics
A DOUBLE-BEAM PHOTOELECTRICAL SPECTROMETER [DWUKANALOWY SPEKTROMETR FOTOELEKTRYCZNY]
H. Niewodniczanski, K. Melzacki, J. Pietruszka, and J. Pilawa Oct. 1964 23 p In POLISH; ENGLISH summary Submitted for Publication
(Rept.-317)

The design and construction of a new optical spectrometer are described. Two exit slits isolate the selected lines in the spectrum of a standard spectrograph. The emerging radiation is brought to the cathode of the photomultiplier tube by two plane mirrors and special guide pipes with reflecting inside walls. Each exit slit can be moved along the spectrum by the long micrometer screw. The instrument records either a time-resolved spectrum of a pulsed event or the total spectrum of a constant intensity radiation source. Author

N65-23019# Texas Instruments, Inc., Dallas. Apparatus Div.
MULTI-SENSOR SYSTEMS Monthly Status Report, 1–28 Feb. 1965
1 Mar. 1965 2 p
(Contract AF 33(615)-1457)
(U2-61179-2)

The image processor viewer performed well in preliminary flight tests. The 20-kV power supply was replaced, and the spare processor chemical tank used in the experiment was found unrepairable. G.G.

N65-23173*# Michigan Univ., Ann Arbor.
INSTRUMENTATION FOR MEASUREMENT OF COSMIC NOISE AT 0.75, 1.225 AND 2.0 Mc/s FROM A ROCKET Final Technical Report
H. F. Schulte, H. W. Estry, R. L. Miller, and J. W. Kuiper Washington, NASA, May 1965 116 p refs
(Contract NASw-54)
(NASA-CR-228) CFSTI: HC $4.00/MF $0.75

This report describes design considerations and performance characteristics of a complete rocketborne instrumentation system for absolute intensity measurements of the radio frequency noise energy which originates primarily in the halo of our galaxy. All portions of the system utilize fail-safe circuits, alternate channel redundancy, and conservative design techniques wherever possible. Simultaneous cosmic noise measurements can be made while in and above portions of the ionosphere at frequencies of 0.75, 1.225, and 2.0 Mc. Since the reactive component of the radio astronomy antenna impedance is affected by the ionosphere, it also is measured periodically throughout the flight. The instruments described were successfully fired to an altitude of 1691 kilometers. Author

N65-23178# Southern Research Inst., Birmingham, Ala.
DESIGN STUDY TO DEVELOP INSTRUMENTATION FOR FIELD EVALUATION OF CHEMICAL AGENTS Monthly Progress Report
Alvin N. Bird, Jr. 17 Jan. 1964 11 p
(Contract DA-18-108-AMC-32-A)
(AD-429545)

Progress on the engineering evaluation of the oxime cell and the aerosol flash camera is reported. The flow rates used in the evaluation of the cells were these: 4 drops/min oxime; 1 liter/min clean N_2; and N_2 + 1.4 microgram HCN/liter at the rate of 1 liter/min. The most important results were the following: (1) The background current was essentially constant at 2 to 3 microamperes with fluctuations of 10% or less. (2) The total output of the cell was essentially constant for a given agent concentration. (3) The response time of the cell was from 3.5 sec to 7.5 sec. (4) The internal resistance of the cell was about 11 000 ohms. (5) For an oxime flow rate through the cell in the range 4 drops/min to 1/5 drop/min, little effect on cell response time was observed within 5% to 10%. (6) As the temperature was changed from 20° to 40° C, the response time decreased by about 15%, flow rate was essentially constant, cell background increased, and signal output increased. Electrode configurations, new cell design, and the aerosol flash camera are also discussed. E.E.B.

N65-23206# Army Engineering Research and Development Labs., Fort Belvoir, Va.

EFFECT OF ENLARGEMENT OF A PHOTOGRAPHIC IMAGE ON SOME MEASURING PROPERTIES OF AERIAL PHOTOGRAPHS [VLIYANIYE UVELICHENIYA FOTOIZOBRAZHENIYA NA NEKOTORYYE IZMERITEL'NYYE SVOYSTVA AEROSNIMKOV]

V. F. Deyneko [1964] 14 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 5, 1964 p 42–48
(ERDL-T-177; AD-611333)

An aerial photograph enlarged to the scale 1:M, and obtained from an aerial negative taken from a great height, in many respects has better measuring properties than does a contact print from an aerial negative taken directly in the scale 1:M from a lower height. It is more feasible for the contour and composite surveys to conduct the photographing from as great a height as possible, taking into account the maximum enlargement ratio at which a satisfactory photographic quality of the aerial negatives is obtained. It is possible to conduct aerial photographing to large and medium scales of surveying, figuring on a subsequent magnification of the aerial photographs by 4 to 8 times. In addition, in many cases, the various establishments can successfully utilize the already available aerial negatives from prior surveys with an enlargement of the photo-image by 3 to 4 times, and sometimes even more. The enlargement ratios will increase in value in proportion to the development of science and technology. The use in production of high enlargement ratios for a photo-image will permit us to raise appreciably the output and economy of the aerial photogeodetic operations in contour and composite surveying without a decrease in the accuracy of the maps and charts. TAB

N65-23236# Mississippi State Univ., State College. Dept. of Aerophysics

A DEVICE FOR THE DIRECT MEASUREMENT OF UNSTEADY AIR FLOWS AND SOME CHARACTERISTICS OF BOUNDARY LAYER TRANSITION

Joseph J. Cornish, III Ft. Eustis, Va., Army Transportation Res. Command, Mar. 1965 24 p refs *Its* Res. Note No. 24
(Contract DA-44-177-AMC-892(T))
(USATRECOM-TR-65-12; AD-614008)

A device for use in obtaining instantaneous velocity profiles of unsteady airflows is described. The techniques for its use are illustrated by two typical examples in laminar and turbulent boundary layers. Author

N65-23291*# Ling-Temco-Vought, Inc., Dallas, Tex. Military Electronics Div.

LUNAR CONTOUR MAPPING SYSTEM (LUCOM) Final Report, 5 Aug. 1964–18 Mar. 1965

G. M. Goldberg, W. C. Hallmark, and R. H. Myers 31 Mar. 1965 354 p refs
(Contract NAS9-3269)
(NASA-CR-65001; Rept.-4-31200/5R-30) CFSTI: HC $7.00/MF $1.75

Results of this Phase I LUCOM investigation indicate that (1) a practicable radar sensor can be designed for operation at 80 nautical miles above the lunar surface; (2) the data could be converted into digital form and transmitted back to earth for processing; (3) methods and techniques can be conceived for recreating the profiles and using them to map local features; (4) altimetry readings can be used, in combination with associated Apollo data, to recompute a more accurate lunar figure; and (5) the total system can be designed within the physical limits imposed by the Apollo environment. Author

N65-23312# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.

ELECTRON TIME OF FLIGHT SPECTROMETER

G. C. Baldwin 28 Oct. 1964 6 p
(Contract Nonr-3942(00))
(ASR-2; AD-611128)

The work to date has shown that the principle of velocity selection by time-of-flight measurement is applicable to slow electrons. Energies below 0.25 volt have been detected, and there seems to be hope that this can be extended downward by at least a factor of 5. The present limits are set by practical problems of shielding, light source duration, interactions of the sample gas with emitter and detector surfaces and contact emf changes. The accuracy of measuring cross sections will be limited mainly by the pressure measurement technique and the interactions of the sample gases with surfaces in the spectrometer. This spectrometer can be adapted with relatively minor changes to studies of electron reflection, of secondary emission, photoelectric spectra, adsorbed films, and surface states of solids. TAB

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-22332# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.

A REPORT GUIDE TO GAMMA RADIOGRAPHIC LITERATURE

Ernest H. Rodgers and Satrak Der Boghosian Aug. 1964 104 p refs
(AMRA-MS-64-11; AD-612042)

This guide consists of a bibliography of items currently in the AMRA nondestructive testing information retrieval system covering the subject of gamma radiography. Where available, each item in this journal consists of the following information: (1) item, report, or article title; (2) author or authors; (3) source or facility; (4) report number or identification; (5) date; and (6) abstract. Word descriptors pertinent

to each item are listed in alphabetical order and are cross-referenced by the AMRA identification number. Also provided is an author index or, if no author is available, then the issuing organization is listed. TAB

N65-22333# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
A REPORT GUIDE TO LITERATURE IN THE FIELDS OF FLUOROSCOPY AND REMOTE VIEWING TECHNIQUES
Charles P. Merhib and Satrak Der Boghosian Aug. 1964 43 p refs
(AMRA-MS-64-13; AD-612045)

This guide consists of a bibliography of items currently in the AMRA nondestructive testing information retrieval system covering the subject of fluoroscopy and remote viewing techniques. Where available, each item in this journal consists of the following information: (1) item, report or article title; (2) author or authors; (3) source or facility; (4) report number or identification; (5) date; and (6) abstract. Word descriptors pertinent to each item are listed in alphabetical order and are crossreferenced by the AMRA identification number. Also provided is an author index or, if no author is available, then the issuing organization is listed. TAB

N65-22334# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
INVESTIGATION OF CONTAMINATION TOLERANCE LEVEL FOR HYDRAULIC PUMPS Quarterly Technical Report, 1 Oct. 1964–31 Jan. 1965
Richard H. Hollinger [1965] 9 p
(Contract AF 33(615)-2009)
(Q-B2289-1; AD-611418)

Test systems were designed, and their construction was almost finished. Components include valves, sump, drive motor, torque reducer, and heat exchanger. The sump has a baffle plate on the inlet tube to prevent foam from entering the pump, possibly causing cavitation. The inlet tube is perforated so that the flow (24 g.p.m. at 2400 psi operation) will give good mixing of contaminant with the hydraulic fluid without other agitation. TAB

N65-22351# Air Force Systems Command, Kirtland AFB, N. Mex. Weapons Lab.
A UNIQUE TECHNIQUE FOR CUTTING GUARD-RING GROOVES IN QUARTZ CRYSTALS Technical Report, Jul.–Nov. 1964
Richard D. Thomas Feb. 1965 19 p refs
(WL-TR-64-171; AD-412461)

The quartz crystal transducer has found wide application in measuring pressure profiles of shock waves in solid materials. When using the quartz crystal in this manner, it is necessary to separate the positive plated surface to form two electrodes. This is done by cutting a narrow concentric groove in the surface. The method described is believed to surpass any known method in the conservation of both material cost and man-hours. This technique produces a groove with a width between 0.003 inch and 0.005 inch and concentric within 0.0005 inch over the entire diameter. Author

N65-22375# ARO, Inc., Arnold Air Force Station, Tenn.
TESTS OF DRY COMPOSITE LUBRICATED GEARS FOR USE IN AN AEROSPACE ENVIRONMENTAL CHAMBER
T. L. Ridings Arnold Eng. Develop. Center, Mar. 1965 55 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-45; AD-460502)

The results are reported of a test program set up to determine the operational characteristics of dry composite lubricated gears. Two diametral pitch sizes, 7 and 12, and two gear materials, nitralloy steel and nodular iron, were tested. Three dry composite lubricants and one low vapor pressure grease were tested. All three dry composite lubricants provided adequate lubrication for periods of up to 300 hr at 100 rpm with very little wear of either load gears or lubricating idlers. The MoS_2-fortified, grease-lubricated gears failed after 40 hr of operation. Author

N65-22403# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUBRICATION FOR THE HOT ROLLING OF STEEL PIPE
P. I. Chuyko, M. S. Goncharevskiy, and Ye. I. Tsyganck 18 Mar. 1965 4 p Transl. into ENGLISH from Russian Patent no. 161857 (Appl. no. 834359/23-4), 3 May 1963
(FTD-TT-64-1086/1; AD-613159)

A lubricant for the hot rolling of steel pipe consisting of an aqueous solution of graphite and Chile saltpeter with a calcium hydroxide additive for improving the quality and eliminating manual operation is described. The composition of the proposed lubricant and procedures used in its preparation are discussed. The lubricant can be used on pipes ranging in temperature between 300° to 500° C and can be applied by using a crane to dip batches. S.C.W.

N65-22421# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
EFFECTS OF REACTOR RADIATION ON FIVE HIGH-TEMPERATURE SOLID-FILM LUBRICANTS
R. H. Mc Daniel Kirtland AFB, N. Mex., AF Weapons Lab., Feb. 1965 128 p refs
(Contract AF 29(601)-6213)
(FZK-212; WL-TR-64-158; AD-613561)

Nuclear reactor irradiation and laboratory testing were performed on five high-temperature solid-film lubricants. The specimens were exposed to an average gamma dose of 2.2×10^{11} ergs/gm(C) and associated neutrons of 5.2×10^{16} n/cm^2 (E>2.9 MeV). Several test temperatures were investigated for each lubricant. Weibull plots and a ranking method were employed for data analysis. Reactor radiation had no significant effect on the wear life of the PbS + MoS_2 + B_2O_3 or the CaF_2 lubricants. However, detectable decreases in wear life were noted at 80° F for Dynalube and at 900° F for Almasol SFD-810. The wear life of MoS_2 + graphite + sodium silicate suffered a decrease at 80° F but improved at 600° and 1200° F. Author

N65-22441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLID MOLYBDENUM DISULFIDE LUBRICANT
Ye. I. Berniker 18 Mar. 1965 6 p Transl. into ENGLISH from Mashinostr. (Kiev), no. 2, 1964 p 25
(FTD-TT-64-1148/1; AD-613178)

The use of solid molybdenum disulfide (MoS_2) as a lubricant for increasing the staying power and capacity of cutting tools as gear wheel cutters, and for the frictional parts of machines such as press fits is reported. Solid MoS_2 can be applied by spraying under pressure, smearing, or in the form of pressed pencils. Solid MoS_2 can be used in a vacuum, or at temperatures from 70° to 380° C; it is not a conductor of electricity, and does not collect dust. The use of the solid

lubricant for bearings showed the possibility of using these lubricants for improving conditions of machining metals by cutting and pressure. The resistance of gear wheel cutters increased from 50% to 100% and the percentage of cutters required for finishing off unevenness was lowered from 50% to 5%. Lubrication of operating files with a colloid solution of MoS_2 in alcohol increased the production of files by 50% to 66%. S.C.W.

N65-22443* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF FORMING A CUTTING CAVITY BY CHARGES WITH A CUMULATIVE EFFECT
V. F. Vedutin 22 Mar. 1965 5 p Transl. into ENGLISH from Russian Patent no. 160975 (Appl. no. 807041/22-3), 7 Dec. 1962 2 p
(FTD-TT-64-1191/1; AD-613454)

The object of the invention is a method of forming a cutting cavity by charges of cumulative action. To increase the expenditure of explosives, the blast holes for the cumulative charges are arranged more or less in a circle, and more or less in the center there is located the blast hole for the regular charge. The cumulative charges in the blast holes are mainly arranged from the coal face to the middle of the length of the blast hole, and the regular charge from the middle up to the mouth of the blast hole. The cumulative charges are exploded at the same time and with a delay with relation to the explosion of the center blast hole. TAB

N65-22492# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
A REPORT GUIDE TO AUTORADIOGRAPHIC AND MICRORADIOGRAPHIC LITERATURE
Ernest H. Rodgers Aug. 1964 32 p refs
(AMRA-MS-64-10; AD-612047)

This guide consists of a bibliography of items currently in the AMRA nondestructive testing information retrieval system covering the subjects of autoradiography and microradiography. Where available, each item in this journal consists of the following information: (1) item report, or article title, (2) author or authors, (3) source or facility, (4) report number or identification, (5) date, and (6) abstract. Word descriptors pertinent to each item are listed in alphabetical order and are cross-referenced by the AMRA identification number. Also provided is an author index or, if no author is available, then the issuing organization is listed. TAB

N65-22524# Battelle Memorial Inst., Columbus, Ohio.
DESIGN MANUAL FOR SUPERCRITICAL-SPEED POWER-TRANSMISSION SHAFTS
[1964] 32 p refs
(Contracts AF 33(616)-8290; AF 33(657)-10330)
(AD-610645)

This manual contains information which will enable the users to design power-transmission shafts operating at supercritical speeds. It contains recommendations on the number and location of dampers required, and the required damping coefficient, weight, and spring rate of the dampers. Author

N65-22556*# IIT Research Inst., Chicago, Ill. Mechanical Engineering Div.
FEASIBILITY STUDY OF TECHNIQUES TO PROTECT MECHANISMS OPERATING IN SPACE FROM MALFUNCTION. PART I: SURVEY AND ANALYSIS Final Report, 28 Jun. 1963–27 Jun. 1964
W. E. Jamison 30 Nov. 1964 88 p refs
(Contract NAS8-11014)
(NASA-CR-62281; K-6055, Pt. I) CFSTI: HC $3.00/MF $0.75

A literature survey and analysis of currently available antifriction techniques for space mechanisms were conducted to determine their operational characteristics and limitations in terms of environmental parameters. The techniques are assessed for their underlying theoretical principles and predictions are made of their performance potentials. It is concluded that significant improvements in performance of space mechanisms must be preceded by a better understanding and control of friction and wear properties of interfaces. Specific recommendations are made for research and development to accomplish this. Author

N65-22557*# IIT Research Inst., Chicago, Ill. Mechanical Engineering Div.
FEASIBILITY STUDY OF TECHNIQUES TO PROTECT MECHANISMS OPERATING IN SPACE FROM MALFUNCTION. PART II: EXPERIMENTAL RESULTS AND RECOMMENDATIONS Final Report, 8 Jun. 1963–27 Jun. 1964
W. E. Jamison Jan. 1965 50 p refs
(Contract NAS8-11014)
(NASA-CR-62282; C-6055, Pt. II)

Studies were conducted to establish techniques for providing a composite picture of friction interface as it relates to the friction process. Techniques used were X-ray diffraction, contact potential measurements, and residual gas mass spectrometry. Parameters investigated were (1) interfacial molecular composition; (2) crystal lattice spacing; and (3) surface contact potential as affected by sliding and by adsorption of gaseous species. It was shown that techniques used contributed significantly to the understanding of the fundamental processes involved in friction, and to the development of interfaces with low friction properties. The use of ultra-high vacuums extended the time available for measurements of gas–surface interactions. Contact potential measurements provided a convenient, speedy means for characterizing the electrical state of friction surfaces and for quantitatively defining adsorption processes when used in conjunction with partial pressure measurements. Other techniques being developed for friction studies on a molecular scale are low energy electron diffraction, secondary electron emission, and field emission microscopy. S.C.W.

N65-22561*# Mechanical Technology Inc., Latham, N. Y.
ANALYSIS OF THE HYDROSTATIC JOURNAL AND THRUST GAS BEARING FOR THE NASA AB-5 GYRO GIMBAL BEARING
J. W. Lund, R. J. Wernick, and S. B. Malanoski 23 Oct. 1962 178 p refs Prepared for GE
(Contract NAS8-2588)
(NASA-CR-62280; MTI-62TR26) CFSTI: HC $4.00/MF $1.00

Analytical study of static and dynamic load carrying capacity and flow for externally pressurized, gas lubricated journal and thrust bearing with orifice restricted feeding is described. Approximate analysis of static load and flow for the journal and thrust bearing is restricted to small values of the eccentricity ratio. The number of orifice restricted feeding holes is assumed such that the feeding planes become line sources. The solution is a first-order perturbation calculation on the eccentricity ratio. Analysis is made of static load and flow for the thrust bearing where the orifices are represented by point sources, and an approximate analysis of static load and flow for the journal bearing with the orifices as point sources is made. Approximate analyses are also made of the static load for the journal bearing, valid for all eccentricity ratios, and of the dynamic stiffness for the journal and the thrust bearing. Author

N65-22566*# Cadillac Gage Co., Detroit, Mich.
HYDRAULIC SERVOVALVE RELIABILITY IMPROVEMENT STUDY FOR NASA Progress Report No. 5, Nov. 1–Dec. 1, 1964
[1964] 26 p
(Contract NAS8-11630)
(NASA-CR-62278; CG9-13) CFSTI: HC $2.00/MF $0.50

The brazed jet pipe and armature assembly, torque motor testing, and preliminary development of the complete servovalve are evaluated. Initial testing of the servovalve led to the conclusions: (1) Excessive null shift and instability result if the nozzle jet stream is not concentrated and constant over the range of pressures up to the operating pressure of the valve. (2) Flat faced airgaps are more efficient in torque motor design than the ones encircling a round armature. It was theorized that flat faces permit the magnetic lines of flux to remain parallel to each other and to bridge the gap at right angles. In a round armature and pole face design, it appears that excessive concentration of flux occurs at the outer edges of the poles resulting in greater stray losses. G.G.

N65-22672# General Electric Co., Schenectady, N.Y. Research Lab.
INVESTIGATION OF THE NATURE OF STRUCTURAL DAMAGE IN METAL-FORMING PROCESSES Quarterly Report, Oct. 19, 1964–Jan. 18, 1965
H. C. Rodgers, R. C. Leech, and L. F. Coffin, Jr. Feb. 1965 15 p ref
(Contract NOw-65-0097-f)
(QR-1; AD-612255)

Progress is reported on an investigation to acquire an understanding of the way in which hydrostatic stresses influence the initiation and propagation of failure in materials, to be able to relate the degree of damage in a particular material to the amount of deformation under a particular state of stress, to categorize materials as to their susceptibility to damage under a particular set of processing conditions, and to predict for any process those conditions which will lead to the development of the most favorable states of hydrostatic stress and which will produce the minimum amount of damage to the material being processed. Work has been performed in the following areas: (1) development of high-pressure fluid facilities; (2) development of high precision density measuring facilities; (3) ambient pressure sheet drawing; and (4) lubrication and die friction studies. TAB

N65-22692# United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Fifth Quarterly Report, 1 Jul.–30 Sep. 1964
J. F. Dudenhoefer [1964] 18 p refs
(Contract DA-36-039-AMC-03625(E))
(EBR-156; AD-612116)

Six engineering sample tubes (four 6914A and two 6544 tubes) were successfully fabricated using the electron beam welding facility which has been established. Five preproduction tubes (four 6014A and one 6544) were successfully fabricated using the electron beam welding facility and partially tested on the approved testing facilities. For fabrication of tubes with internal photosensitive surfaces, it is necessary to prevent contamination of the photo surfaces due to oil backstreaming from the oil diffusion pump of the electron beam facility: this was accomplished by installation of a liquid nitrogen baffle on the diffusion pump. TAB

N65-22705# Joint Publications Research Service, Washington, D. C.
ELECTRON-BEAM WELDING OF CHROMIUM
S. M. Gurevich and G. K. Kharchenko 29 Apr. 1965 8 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 12, Dec. 1962 p 56–59
(JPRS-29812; TT-65-30848) CFSTI: $1.00

The mechanical properties of chromium joints welded by the electron-beam method in a vacuum were investigated. Welding in a chamber with a vacuum of 1 to 2 × 10^{-5} mm Hg resulted in a complete fusion of the edges and gave satisfactorily formed seams. A certain sublimation of the chromium was observed. Comparison with joints welded by electric arc fusion in a chamber with controlled atmosphere, and also by manual welding in argon in free air, showed that a minimum seam width was obtained with electron-beam welding, and that the seam was light colored and showed no oxidation. Microanalysis of all welded seams revealed elongated large grains for all welding methods, however the comparative thickness of the crystallites was less for the electron-beam seam. Gas analysis showed that the seams welded by electron beam were the least contaminated by oxygen, nitrogen, and hydrogen. Annealing of the welded joints at 600° C decreased the transition point somewhat from the viscous to the brittle state. Vacuum electron-beam welded joints had the lowest temperature of transition into the brittle state, and showed nearly the same strength and plasticity as the base metal. G.G.

N65-22745 Army Materials Research Agency, Watertown, Mass.
RE-ENTRY VEHICLE FOR RADAR SELECTIVITY EVALUATIONS
R. M. Colton and E. B. Dobbins *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 179–192 refs (See N65-22732 12-34)

Model reproductions of about one-quarter scale of reentry vehicles were evaluated. Molybdenum alloy, Inconel X, 5052 aluminum alloy, Mo-TZM, and phenolic-fiberglass composite were materials tested for the simulated vehicles. The materials were fabricated using the techniques of shear spinning, tape wrapping, plasma arc spraying, and welding. Shear spinning of Inconel X, 5052 aluminum alloy, and Mo-TZM reentry vehicle configurations was accomplished at predetermined temperatures, using specific reduction rates and ratios. A 128-111 finish fiberglass cloth, impregnated with a phenolic-type resin which is wrapped over a 5052 aluminum shear spun substrate was used for wrapping, curing, machining, and shear spinning fabrication of the ablative reentry vehicles. L.S.

N65-22746 Army Engineer Research and Development Labs., Fort Belvoir, Va.
IMPROVED DIELECTRIC FILMS FOR OPTICAL AND SPACE APPLICATIONS
J. T. Cox, G. Hass, and J. B. Ramsey *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 193–205 refs (See N65-22732 12-34)

Deposition techniques and treatments, such as evaporation by electron bombardment, deposition in the presence of oxygen, and ultraviolet irradiation after film deposition, have produced durable optical coatings of Si_2O_3, SiO_2, Al_2O_3, ThO_2, and ZrO_2. Among the applications in which these oxide films proved particularly useful were the following: (1) Silicon dioxide films (SiO_2) are suitable for producing chemically and mechanically durable protective layers for front surface mirrors. (2) Because of their hardness and excellent adherence, evaporated aluminum oxide (Al_2O_3) films are used for aluminum front surface mirrors. (3) Thorium dioxide (ThO_2) films are transparent throughout most of the ultraviolet region

and have a relatively high refraction index. They are combined with low-index silicon dioxide films for producing multilayer interference filters and multilayer polarizers for the ultraviolet region. (4) Various combinations of these oxide films are effective for coating solar-powered thermal systems, and are used as test coatings on satellites to study erosion effects. Data on the preparation and optical properties of each oxide are given. M.G.J.

N65-22760 Frankford Arsenal, Philadelphia, Pa.
EVAPORATION OF ORGANIC COMPOUNDS FROM METAL AT HIGH VACUUM
H. Gisser and S. Sadjian *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 391–403 refs (See N65-22732 12-34)

The evaporation of the last monolayers of hydrocarbons from metal surfaces was investigated. Experimental data on the coefficient of friction for surfaces incompletely covered with friction reducing films are presented, and the relationship of pressure to the fraction of monolayer remaining on the metal surfaces is discussed. The coefficients of friction obtained on the hydrocarbons in the evaporation experiments at 25° C are shown. It was found that the last layer of dodecane was removed at 7×10^{-3} torr or higher, while with hexadecane and octadecane, the last layers were not completely removed at 5×10^{-6} torr. Further, evaporation experiments on dodecanol-1, n-dodecylamine, and octadecanol-1 at 25° C showed that substantially none of the last monolayer was removed at pressures in the neighborhood of 10^{-6} torr. Also, at 2 to 5×10^{-6} torr the last monolayer was progressively removed as the temperature increased. Removal was not complete at 80° C. The ease of removal of the hydrocarbon layers in contrast to the alcohols and the amine reflects the difference in absorption energy. E.E.B.

N65-22848*# Standard Pressed Steel Co., Jenkintown, Pa. SPS Labs.
EVALUATION OF FASTENERS AND FASTENER MATERIALS FOR SPACE VEHICLES Annual Report, Nov. 1963–Nov. 1964
J. J. Glackin and E. F. Gowen, Jr. 31 Dec. 1964 401 p
(Contract NAS8-11125)
(NASA-CR-62458) CFSTI: HC $7.00/MF $2.00

The objectives were to characterize those fasteners and materials most suitable at temperatures from −423° F (−253° C) to 1600° F (871° C). The space vehicle industry's present and future fastener requirements were determined. Information included present and future fastener materials, configurations, application and design criteria, testing and test methods, and fastener information and specifications. Twenty-one different classes of fasteners selected for evaluation consisted of variations in tension and shear bolts, blind bolts, structural rivets, and companion fasteners fabricated from within the specified base alloys of iron, nickel, titanium, and aluminum. They were tested to determine these properties or exposure effects: tensile, shear, stress rupture, stress relaxation, nut reusability, nut vibration, corrosion resistance, effects of thermal cycling, and the effects of relaxation on mechanical properties. Tests to characterize fasteners for space vehicle applications are being determined. The alloys of iron, nickel, and titanium base evaluated were selected from the results of the survey on the basis of potential for high strength fastener applications, and expectant future usage. Selected were Ti 1Al–8V–5Fe, 18% nickel maraging steel (Vasco Max 300), U-212, Inconel 718, and 25% cold reduced Waspaloy. Author

N65-22853 Joint Publications Research Service, Washington, D.C.
NEW DEVELOPMENTS IN PLANETARY ROLLING MILLS
Hu Hsing *In its* Transl. on Communist China's Sci. and Technol. No. 169 13 Apr. 1965 p 8–13 Transl. into ENGLISH from K'o-Hsueh Hua-Pao (Shanghai), no. 7, Jul. 1964 p 264–265 (See N65-22852 12-34) CFSTI: $2.00

A single planetary steel-rolling mill is described, and is recommended for small-quantity, high-quality sheet steel production. This new design differs from conventional planetary rolling mills in two significant ways: there are fewer working rolls, and they are spaced further apart around the supporting roll; the supporting roll and its planets are opposed by a cambered plate rather than by another roll. The single planetary roll model thus requires no synchromesh mechanism. There are brief moments when the machine is not bearing down on the sheet, which allows the sheet to cool. This process is somewhat slow but it improves the surface quality of the steel sheet. J.M.D.

N65-22854 Joint Publications Research Service, Washington, D. C.
PRODUCTION AND APPLICATION OF POWDER METALLURGY MACHINE PARTS IN CHINA
Wen-Chih Chung *In its* Transl. on Communist China's Sci. and Technol. No. 169 13 Apr. 1965 p 23–36 ref Transl. into ENGLISH from Shang-Hai Chi-Hsieh (Shanghai), no. 9, 25 Sep. 1964 p 24–28 (See N65-22852 12-34) CFSTI: $2.00

Powder metallurgy and its industrial applications in Communist China are surveyed. Production processes and product purity of various forms of iron, copper, and bronze powder are reported briefly. Powder metallurgy products used in the textile and automobile industries are discussed. Oil-impregnated bearings and steel collars are used extensively in China's textile machinery, and in automobile production iron–graphite oil-impregnated bearings and clinker-built piston rings are being manufactured. Various other applications to machinery for industrial and consumer use are mentioned. A summary of powder metallurgy in the United States is given. J.M.D.

N65-22868# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board
MATERIALS ADVISORY BOARD AD HOC COMMITTEE ON METALWORKING PROCESSES AND EQUIPMENT First Progress Report
William Rostoker et al (ITT Res. Inst., Chicago) 15 Mar. 1965 32 p refs
(Contract ARPA SD-118)
(MAB-206-M; AD-613062)

The government metalworking processes and equipment program is a cooperative effort of the military services and National Aeronautics and Space Administration to support studies of deformation theory which will lead to the improvement of manufacturing technology. At the request of the Department of Defense the Materials Advisory Board Committee on metalworking processes and equipment is assisting in the planning and technical phases of the program. The committee has assessed the potential of vibrational energy technology and hydrostatic extrusion which were the subjects of recent government-sponsored symposia, and have submitted conclusions and recommendations as to the value and limitations of these processes and the manner in which the development of each should be undertaken. A study of superplasticity phenomena was initiated by the committee. Author

N65-22928# Naval Air Station, Pensacola, Fla. Materials Engineering Div.
EFFECTIVENESS OF THE SPECTROMETRIC OIL ANALYSIS METHOD FOR MONITORING AIRCRAFT MECHANISMS

B. B. Bond 26 Jun. 1964 10 p ref
(OA-20-64; AD-609746)

An investigation of the potentialities of the spectrometric oil analysis method for monitoring aircraft engines and other aircraft mechanisms is reported. The reliability of the method for detecting abnormal wear in oil lubricated aircraft mechanisms, such as metal parts in frictional contact, is discussed. The applicability of the oil analysis technique to turbojet engines was also evaluated. Results of a study on seven discrepant jet engines showed these facts: (1) Oil analysis provided preindications of failure in six of the seven engines. Other evidence of failure was found in only two of the seven. (2) Oil analysis provided warnings in time to avert inflight failures in four of the engines. Delay in transit time of oil samples for two of the remaining three engines prevented a more thorough study. (3) Two of the three inflight failures resulted in total loss of the aircraft. Oil analysis is credited with the detection of two of the discrepant engines that did not fail in flight. S.C.W.

N65-22936# Naval Air Station, Pensacola, Fla. Materials Engineering Div.
INVESTIGATION OF THE FEASIBILITY OF AN AIRCRAFT-OIL ANALYSIS SYSTEM FOR OPERATIONAL USE IN THE FIELD, PHASE II
B. B. Bond 14 Sep. 1964 8 p refs Review of TRECOM TR-63-55
(OA-37-64; TRECOM-TR-63-55; AD-609743)

A critique is presented on a previous statistical study to evaluate oil analysis for wear metals as a method for detecting incipient failure in aircraft engines. It was shown that the sole basis for the statistical study was the segregation of the engines into three groups. Therefore, the validity of the study must depend upon the ability to classify each engine as belonging in one of the three groups. As the basic information that would make such classifications possible was not available, the conclusions of the statistical study are not valid. Therefore, another program for evaluating the oil analysis program is discussed for reciprocating engines. Statistical data are presented for a 4-year period from October 1, 1959 to October 1, 1963, and for the 1-year period from October 1, 1962 to October 1, 1963. E.E.B.

N65-23021*# Speer Carbon Co., Niagara Falls, N. Y. Research Lab.
DEVELOPMENT OF A HIGH RESISTIVITY PASTE FOR THE SCREENED CIRCUIT PROCESS Final Report, Jul. 1963–Jun. 1964
F. M. Collins 26 Jun. 1964 50 p
(Contract NAS1-3155)
(NASA-CR-62605)

The objective of this program, development of high-value, semiprecision glaze resistors prepared by screen printing suitable pastes on an electroceramic substrate and firing at about 600° C, can be met with previously developed pastes made from mixtures of thallium oxide and glass. The effects of various process and composition variations on resistor properties were investigated. Variations included the proportion of thallium oxide, particle size of paste ingredients, terminal material, firing schedule and glass composition. Resistive elements in values up to 1 megohm per square were prepared with a high degree of reproducibility. Characteristics included a temperature coefficient under 350 ppm/C°, a voltage coefficient under 60 ppm/volt, and an instability under various thermal, electrical, and humidity tests of less than 1% in most cases. Properties of the resistors were uniform. These pastes are especially compatible with ceramic substrates of higher C. T. E. Although performance on alumina was unsatisfactory, a formulation was devised which provides characteristics only slightly inferior to those cited. Author

N65-23031# Electro-Optical Systems, Inc., Pasadena, Calif.
REPLICA OPTICS Final Report, 14 Feb.–12 Sep. 1964
D. E. Stewart 26 Feb. 1965 144 p refs
(Contract DA-04-495-AMC-376(A))
(EOS-4821-Final; AD-611417)

The scope of the program was directed to the replication of concave spherical mirrors having a diameter of 4 inches. These objectives were achieved: An analysis of the replication process was updated; production processes were specified; 4 masters were received or fabricated; 7 submasters were made; preforms were procured; adhesives and coatings were investigated; fixtures were improved; 39 replicas plus 3 replicas by submastering were made and analyzed. The environmental and optical tests are described. Author

N65-23033# State Univ. of Iowa, Iowa City. Dept. of Industrial and Management Engineering
MAXIMIZATION OF SYSTEM RELIABILITY USING A DIGITAL COMPUTER AND OSCILLOSCOPE SEARCH TECHNIQUES
Roger K. Hoppe (M.S. Thesis) Jan. 1965 88 p refs
(AD-611566)

The purpose of the paper is to devise a systematic method of searching for the optimal Lagrange multiplier through the use of a digital computer in a direct tie with an on-line oscilloscope. The method is a considerable aid in converging on the optimal Lagrange multiplier in a minimum number of iterations. The use of an on-line oscilloscope with the digital computer offers a relatively new method of search; it is felt that the general developments in this paper may also have wide application in other nonlinear, search-related problems. TAB

N65-23034# Texas Technological Coll., Lubbock. School of Engineering
MODERN STRESS ANALYSIS IN THE AUTOMOTIVE INDUSTRY
George Ernest Mangrem (M.S. Thesis) May 1965 65 p refs
(AD-611789)

Occupying an important place in automotive engineering are the various techniques that comprise experimental stress analysis. There is no single technique that is most desirable for general use, but each has its place in the laboratory or on the test road, and frequently one complements another. Recent improvements in techniques and materials, along with the successes of the stress analyst, have given new confidence in the value of experimental stress analysis and changed the thinking of management. Many of the major manufacturers now start stress analysis along with basic design and thereby provide a continuous evaluation which has lowered engineering and testing costs, reduced production delays, and eliminated many field failures for lower warranty cost. This report describes representative test procedures along with some of the accompanying modifications and results. Author

N65-23175# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Advanced Development Program
FACE MILLING AND END MILLING H-11 STEEL
Henry Olynik Sep. 1964 20 p refs
(ADR-08-08-64.1)

This investigation was undertaken to solve some of the problems of machining H-11 steel, and to develop parameters for end-milling and face-milling operations. For the machinability tests, parts were designed with relatively deep pockets and thin walls. They were then rough machined, heat treated, and finish machined. Data were accumulated during these operations, and tabulated corresponding to the heat-treat condition of the metal. In addition, optimum machine feeds and speeds were determined, and several aspects of cutter and part design were resolved. Author

N65-23176# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Advanced Development Program
FACE MILLING AND END MILLING OF TITANIUM ALLOYS, 6Al-4V AND 13V-11Cr-3Al
Henry Olynik Sep. 1964 12 p refs
(ADR-08-08-64.2)

The objective was to determine milling parameters for 6Al-4V and 13V-11Cr-3Al titanium alloys and to observe certain aspects of milling these alloys with numerical control apparatus. It was shown that titanium alloys, in general, are considered easier to machine than the superstrength alloys if the recommended speeds and feeds are used. In addition, numerical control equipment can be successfully utilized in the machining of these alloys. Author

N65-23212*# Arde-Portland, Inc., Paramus, N. J.
FABRICATION OF LARGE DIAMETER SPHERES BY THE ARDEFORM PROCESS Final Report
J. J. Cioffi 22 Jan. 1965 53 p
(Contract NAS9-2648)
(NASA-CR-65003)

The design, manufacture, hydrotesting, problem areas, and program results are discussed in detail. All design goals were achieved or exceeded with the exception of the diameter and volume. These two parameters were intentionally sacrificed in the interest of determining repeatability, although they could have been brought within print requirements by straining the material to a lower cryogenic stretch pressure. The resulting sphere would have had a slightly lower ultimate strength level but would have exceeded all design goals by a considerable margin. It was concluded that large diameter spherical vessels can be fabricated by the process to a predetermined size and that a high strength to weight ratio vessel will result. The detail design of the 25-inch sphere is included. E.E.B.

N65-23257# Texas A&M Univ., College Station. Graduate Coll.
A STUDY OF SPRING RATES OF DYNAMICALLY LOADED HELICAL SPRINGS
Franklin Carroll Whitwell (M.S. Thesis) Jan. 1965 58 p refs
(AD-611786)

The spring rates of helical compression springs under harmonic loading at other than natural frequencies are reported. The experimental apparatus and procedures are described. It was concluded that spring rates do not vary with loading frequency if the loading frequency is kept well below the fundamental natural frequency of the spring. According to previous work on this subject, little trouble can be expected from surging if the natural frequency is 12 or more times the rate at which the spring operates. The behavior of one spring which had a natural frequency of approximately 120 cps indicated that when it was vibrated at about one-quarter of natural frequency, its spring rate increased. It was believed that the waveform of the dynamic forces at this frequency was caused by surging. Further, it was recommended that additional studies be made of springs loaded closer to their natural frequency than were the majority of the springs in this study. E.E.B.

N65-23273# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
STABILITY INVESTIGATION OF TILTING-PAD BEARINGS. I: THEORETICAL FOUNDATIONS Interim Report
E. J. Gunter, Jr. and V. Castelli Feb. 1965 81 p refs
(Contract DA-31-124-ARO(D)-147)
(I-B2131-1; AROD-4372-1; AD-613696)

Tilting-pad journal bearings exhibit excellent stability characteristics under ordinary circumstances, but under certain extreme operating conditions they may develop some form of self-excited whirl instability. This report presents the fundamental equations governing the tilting-pad bearing configuration, in which the system geometry, kinematics, and Reynolds equation are developed in detail. A method of analysis of the stability of this type of bearing based on the small perturbation technique is presented. Author

N65-23289*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
BRUSHLESS D.C. TORQUE MOTOR Third Quarterly Report, 25 Dec. 1964–25 Mar. 1965
W. W. Yates and R. E. Skamfer [1965] 17 p
(Contract NAS5-3934)
(NASA-CR-62643; WAED-65-21E) CFSTI: HC $1.00/MF $0.50

Tests on the completed units indicated that the magnet flux was approximately as calculated. The reluctance switch performed approximately as predicted. However, a severe cogging problem in the motor necessitated rewinding the motor stators using a different punching and the installation of a magnetic can in the stator bore. Author

N65-23292*# Pressure Science, Inc., Beltsville, Md.
DESIGN AND DEVELOPMENT OF AN ENCLOSURE SEAL Final Report
John F. Daugherty 15 Feb. 1965 59 p
(Contract NAS8-11606)
(NASA-CR-62480) CFSTI: HC $3.00/MF $0.50

The design and development of a 20-inch diameter metal enclosure seal required to maintain nitrogen gas at 1-atmosphere in an aluminum or beryllium enclosure are discussed. Further seal requirements were that it withstand up to 12 assemblies and disassemblies of the covers, seal in ambient pressures from atmospheric down to 10^{-6} torr, seal in ambient temperatures from −25° to 75°C, and seal for storage periods up to 1 year. Although zero leakage was not maintained in the testing done, results indicated steps to be taken to achieve zero leakage. Decreased flange deflections on the

hemispherical covers and specific changes in the sealing surface characteristics are required. It was recommended that further work in developing metallic enclosure seals use existing prototype hardware. Additional manufacturing would be required only for flange-stiffening rings, sealing surface rework, C-rink rework or manufacture of new seals, and the application of platings and coatings. E.E.B.

N65-23333# Los Alamos Scientific Lab., N. Mex.
FABRICATION OF TEFLON BY HYDROSTATIC PRESSING
J. S. Church, J. K. Donahoe, and H. Sheinberg 7 Apr. 1965 21 p refs
(Contract W-7405-ENG-36)
(LA-3255-MS) CFSTI: $1.00

Functional parts were produced by hydrostatic pressing of Teflon. Pressures ranging from 5000 to 30000 psi can be used. Shrinkage of parts from pressing sac cavity dimensions to the sintered form is anisotropic, but falls into patterns related to both size and shape of the product. All commercially available forms or grades of Teflon were processed satisfactorily. The process is particularly suited to production of shapes difficult or impossible to produce by the more conventional methods described in the literature. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-22274# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
VAPORIZATION OF MATERIALS BY Q-SPOILED LASER PULSES FOR SPECTROSCOPIC ANALYSIS Scientific Report No. 1
P. F. Browne 24 Aug. 1964 15 p refs Revision of Westinghouse Res. Memo 64-9CI-155MI
(Contract AF 19(628)-4184)
(AFCRL-64-871; AD-613536)

This report is a preliminary theoretical analysis of the vaporization of materials by focused high intensity radiation and of the optical emission and absorption properties of the resulting vapor. Author

N65-22300 Army Electronics Labs., Fort Monmouth, N. J.
DIRECT MODULATION OF A He-Ne GAS LASER
Ernst J. Schiel *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 321-329 (See N65-22275 12-34)

Experiments were performed with two different types of He-Ne lasers. The first set of experiments was taken with a laser with confocal mirror configuration emitting in the near infrared at 11530 Å. Pump power threshold for stimulated emission was 17% of the maximum pump power and the length of the plasma column was 35 cm. By modulating the pump power between threshold and maximum, 100% amplitude modulation was achieved. The second set of measurements was made with a laser with hemispherical mirror arrangement emitting in the visible part of the spectrum at 6328 Å. For modulating experiments the pump power was adjusted to a certain carrier level (bias) and then a modulation of 1 kc was applied upon this bias. A completely sinusoidal light modulation resulted if only a small percentage of pump power was modulated. Details of the experiments and the characteristics of both lasers are given. An experimental communications system for one audio channel was built by simply modulating the transmitter as it was originally designed. The receiver consists of the same photodiodes used during the experiments backed up with sufficient amplification to drive the speaker. E.E.B.

N65-22323# Spectra-Physics, Inc., Mountain View, Calif.
HIGH POWER GAS LASER IN THE VISIBLE Quarterly Progress Report, 1 Oct.-30 Dec. 1964
Arnold L. Bloom and Jerald E. Rosemblum [1964] 31 p
(Contract DA-28-034-AMC-00194(E))
(QPR-2; AD-613197)

Experimental results are reported for cw operation in argon and krypton as a function of magnetic fields. These experiments were performed in a tube 1.5 mm in diameter and 28 cm long. A comparison is made between the results obtained with internal mirrors and those obtained with Brewster angle windows. Experiments were carried out on mixtures of gases to determine whether certain types of mixtures enhance the power output of given laser transitions, and whether two laser gases could be made to operate simultaneously. It was found that in the former case the addition of mercury or neon to krypton enhanced laser operation in krypton, but that in the latter case mixtures of krypton and argon did not provide stable discharges. Spectroscopic experiments in argon and krypton lasers verified the I^4 and L^2 relationships at moderate powers and indicated that substantial resolution of Zeeman components occurs in magnetic fields of the order of 1000 gauss. Author

N65-22702# Space Technology Labs., Redondo Beach, Calif.
RESEARCH OF LASER PUMP AND ENERGY STORAGE TECHNIQUES
F. N. Mastrup, R. F. Wuerker, and J. J. Caldwell, Jr. Feb. 1965 133 p refs
(Contract AF 33(615)-1072)
(AFAL-TR-65-22; AD-611771)

A fast high radiance ablating laser pump of novel design has been constructed and its radiative characteristics have been determined. Performance of the lamp for exciting a ruby crystal of 0.580-in. diameter and 8-in. length has been established. Total stimulated emission energies in the range 10 to 30 joules, depending on individual rods, have been verified. Laser energy was emitted in times near 25 microseconds. The stimulated emission pulse consisted of a series of spikes highly regular with respect to their mutual separation and peak power. Maximum measured peak spike power was 2.5 × 1 000 000 watts. Author

N65-22742 Army Electronics Labs., Fort Monmouth, N. J.
THE USE OF INTENSE PINCH DISCHARGES FOR LASER ILLUMINATION
R. G. Buser, J. J. Kainz, and J. J. Sullivan *In* Army Dept. Army Sci. Conf. Proc., vol. I [1964] p 121-134 refs (See N65-22732 12-34)

Two types of gas discharge are studied as light sources for use in optical pumping of laser materials: the types are

theta pinch without electrodes, and linear pinch with electrodes. Experimental results show that pinch discharges can be used effectively as light pumps which are free of certain limitations characteristic of the standard light sources for optical pumping. It was found that high repetition rates are obtainable for certain military applications. The fast pinch discharge mechanism also may eliminate the need for mechanical or electronic Q spoiling. In testing ruby, terbium, and neodymium as laser materials, it appeared that the light source must be tailored for optimum performance. It may be possible to develop new laser materials which match the properties of pinch discharges. J.M.D.

N65-22759 Army Electronics Labs., Fort Monmouth, N.J.
RUBY LASER WITH VIBRATING REFLECTOR
E. A. Gerber and E. R. Ahlstrom *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 375–389 refs (See N65-22732 12-34)

From observations of the character of the temporal output of the ruby laser and of the energy output influenced by the vibrating mirror, it was concluded that the Statz–de Mars theory is based on the assumption of the existence of a single mode in the cavity and predicts equally spaced spikes with exponential decay. The vibrating mirror provides a means for obtaining single mode operation in a solid state laser. However, recent results show that spike patterns do not necessarily indicate single-mode operation. It was shown that spiking is completely regular at lower pumping levels and loses some of its regularity at higher pumping levels. This fits well into the single-mode picture, since higher pumping energy causes the appearance of more modes in the cavity. Further, the dominant axial mode has the lowest losses in the cavity, and higher order longitudinal and transverse modes have increasing losses. If higher order modes are suppressed by the vibrating mirror, more energy will be dumped into the low-loss dominant mode and the efficiency of the laser will increase. E.E.B.

N65-22879# Naval Ordnance Test Station, China Lake, Calif. Test Dept.
DESIGN FOR A LASER RANGEFINDER
T. G. Bergman Dec. 1964 72 p refs
(NAVWEPS-8674; NOTS-TP-3724; AD-611001)

In order to design a laser rangefinder, it is necessary to predict the effect that a change of any variables will have on the expected performance. Preliminary aspects of the overall design are discussed giving a general background in the current state of the art. A derivation of the relationship between the parameters in what is generally called the range equation is shown. Methods for determining the parameters are presented and it is shown how the parameters affect the performance specification. The range equation is computed and the design for a rifle rangefinder is presented. The rifle rangefinder is a portable instrument designed to be mounted on a rifle in place of the usual telescopic sight. It is extremely lightweight (less than 5 lb) and sets the rifle to the correct elevation semiautomatically. Author

N65-22896# Minnesota Univ., Minneapolis. Electrical Engineering Dept.
FIELD PATTERNS IN A RUBY LASER
R. R. Collins and A. Hordvik [1963] 58 p refs
(Contract Nonr-710(61))
(TR-1; AD-612177)

Discussion is first given of the off-axis modes and of the mode selection mechanism. Experimentally it is then shown that radiation did appear at discrete angles with the axis, but some modes that were expected to be seen were not observed. Diffraction patterns were found and they are explained as Fabry–Perot or Fraunhofer patterns. Surface patterns were investigated, and there seemed to be a close connection between the asymmetric distribution of the active region and the occurrence of off-axis modes. The axial and off-axis modes were found to be polarized in the same plane within experimental error. Threshold and delay times were investigated, and good agreement was found between observed data and approximated theoretical calculations. Finally it was found that the intensity of the axial modes increases at a slower rate with input energy when the off-axis modes start occurring. A qualitative explanation is given for this. TAB

N65-22933# Technical Operations Research, Burlington, Mass.
THE INVESTIGATION OF PASSIVE LASER Q-SWITCHING Semiannual Summary Report, 1 Jul. 1963–1 Jan. 1964
J. I. Masters, P. Kafalas, and E. M. E. Murray 31 Jan. 1964 11 p
(Contract Nonr-4126(00))
(TO-B-64-15; AD-609643)

The ability of organic blue dyes and dye solutions to function as possible laser Q-switch materials was studied. Victoria Blue B dye was found to be a successful material when employed as a thin film on an optical flat glass substrate. Results of a comparison of switching speeds of Victoria Blue B film and a synchronized spinning prism indicated that the giant pulse output in each was about the same. The effect of the dye film outside the laser resonator was tested using a spinning prism Q-switch setup. No real difference in pulse height could be measured. In view of the large number of available laser photons per dye molecule overwhelming the passive films, several possible switching processes were studied. Results indicated that a two photon process may occur that could contribute to molecular dissociation. Several solutions, including Victoria B Blue, were tested in acetone and chlorophyll in water. A definite Q-switching effect was observed with both these solutions; however, efficiency was considerably below that of the dye film. The most efficient solution tested was Methylene Blue in water, which had a Q-switching efficiency about five times greater than the other solutions. S.C.W.

N65-23285*# Electro-Optical Systems, Inc., Pasadena, Calif.
LASER BEACON STUDIES Final Summary Report, 30 Jun.–31 Oct. 1961
Paul C. Fletcher 31 Oct. 1961 49 p
(Contract NAS8-2439)
(NASA-CR-62616; EOS-1920-Final) CFSTI: HC $2.00/MF $0.50

A description is given of the various components of a laser beacon together with problems encountered. The weight of the beacon proper for an uncooled system, excluding components for synchronization, is estimated to be about 22 pounds, and the volume about 650-cu in. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-22212# RAND Corp., Santa Monica, Calif.
CORROSION AS A PROBLEM TO THE AIR FORCE
Robert C. Drebelbis (USAF) Mar. 1965 7 p Presented at the AF Logistics Command Commanders' Conf., San Antonio, 12 Mar. 1965
(P-3080; AD-611877)

The following recommendations are made to the Air Force to insure an effective corrosion control program: (1) recognition of corrosion as a major problem at "top side" in DOD and USAF, (2) trained engineers to insure compliance with existing design, procurement, production, modification and maintenance directives at all levels, (3) eliminate the small economics in procurement and production that later develop into costly maintenance and modification requirements, (4) provide for and enforce proper cleaning and protection of weapon systems and ground support equipment in the field. TAB

N65-22231# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
MICROSTRUCTURE DETERMINATION OF MOLYBDENUM-CHROMIUM-VANADIUM STEEL BY MAGNETIC ANALYSIS
Rudolph V. Giangrande Nov. 1964 18 p refs
(AMRA-TR-64-36; AD-611105)

The theory of complex coil impedance is presented, and the effect of steels with varying microstructures on impedance behavior is indicated. A system design employing harmonic analysis is presented, and correlations of electromagnetic properties to microstructure are discussed. Author

N65-22282 Watervliet Arsenal, N. Y.
THE EFFECT OF STRAIN RATE ON YIELDING CHARACTERISTICS OF HIGH STRENGTH ALLOY STEELS
D. P. Kendall *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 79–88 refs (See N65-22275 12-34)

The relationship between the yield strength and the strain rate was determined for a series of high and ultrahigh strength alloy steels at strain rates in the range from 10^{-4} to 10 in./in./sec. Investigations were made for standard 4340 steel (static yield strength of 158 000 psi), a modified 4330 steel (static yield strength of 148 000 psi), a type H-11 high chromium steel (static yield strength of 250 000 psi), and an 18% nickel maraging steel (static yield strength of 275 000 psi). For the four steels, the increase in yield strength over the range of strain rates varied from 4 1/2% to 11%. The increase in yield strength was linear with logarithmic strain rate over some specific increment of strain rate. The extent of this linear range varied with the material from one order of magnitude to five. For all four cases the maximum rate investigated was still within the range of linear strength increase, indicating further increases in strength at strain rates greater than 10 in./in./sec. E.E.B.

N65-22307 Army Materials Research Agency, Watertown, Mass.
BIAXIAL TENSILE BEHAVIOR OF ANISOTROPIC TITANIUM SHEET MATERIALS
Joseph L. Sliney *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 413–426 refs (See N65-22275 12-34)

The influence of a biaxial stress field on the biaxial tensile strength of certain anisotropic titanium alloy sheet materials, and the advantages to be gained through the use of mechanical anisotropy are discussed. Also, the recently proposed anisotropic yield criterion is reviewed and experimental data on two commercially produced titanium-base alloy sheet materials are reported. The mechanical test data—0.2% yield, tensile, biaxial tensile strength—and the anisotropy parameters obtained from various orientations on Ti–5Al–2.5Sn alloy revealed on significant variation of yield and tensile strengths with specimen orientation. Data are also presented on an alpha and an alpha–beta titanium alloy which exhibited mechanical anisotropy and biaxial strength increases of 50% and greater. The assumption should not be drawn that all alpha titanium sheet and all alpha–beta sheet will exhibit anisotropy and biaxial increase. Many titanium sheet alloys have been tested; some exhibited anisotropy and some did not. The all-beta alloy which has a bcc crystal structure does not exhibit anisotropy. E.E.B.

N65-22320# Pechiney Co., Chambery (France).
BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. VOLUME VI: INFLUENCE OF THE DISTRIBUTION OF OXIDE AND OF THE TOTAL IMPURITY LEVEL ON RECRYSTALLIZATION AND GRAIN GROWTH OF BERYLLIUM Final Report, 1 Oct. 1961–1 Oct. 1963
J. Moriceau, J. M. Logerot, M. Croutzeilles, A. Saulnier, R. Syre et al Feb. 1965 94 p
(Contract AF 33(616)-7065)
(ASD-TDR-62-509, Vol. VI; AD-613952)

The influence of oxide distribution and total impurity level on recrystallization and grain growth of beryllium was studied using flake beryllium and lump beryllium as test materials. Results show: (1) Increasing the impurity content in beryllium raises the recrystallization temperature and decreases grain growth by restraining the movement of grain boundaries. (2) At high levels of deformation, oxide distribution was not fundamentally different for either material. (3) Layers of oxide effectively restrain the motion of grain boundaries to the point of making grain growth negligible but do not always constitute an insurmountable barrier for these boundaries. (4) In all cases, the conditions for fabrication play a fundamental role in the subsequent behavior of the metal, especially with respect to the mechanical properties. S.C.W.

N65-22321# Rutgers Univ., New Brunswick, N. J. School of Ceramics
DEVELOPMENT REFRACTORY CERAMICS THAT CAN BE PROCESSED AT TEMPERATURES CONSIDERABLY LOWER THAN THEIR MAXIMUM USE TEMPERATURE Final Report
Edward J. Smoke 31 Dec. 1964 127 p
(Contract NOw-64-0040-d)
(AD-612959)

Effort was in three temperature ranges. At 3000° F and higher, the sintering characteristics of pure alumina, and plus additives, and pure spinel were studied. Effects were determined by property and structure evaluations. Pure alumina plus minor additions of magnesia attained maturity at 2840° F. Matured spinel was realized at 2650° F. From 2600° to 3000° F the presintered approach to the prereacted materials technique was used. Compositions in the high alumina portion of the CaO-Al_2O_3-SiO_2 system were evaluated. In the lowest range, the devitrification approach to the prereacted raw materials technique was utilized. Cordierite was studied. Two approaches were used. First, the whole composition is fritted and used as the sole raw material from which specimens were prepared. Compositions in the MgO-Al_2O_3-SiO_2 system were studied. Second, two devitrifiable frits are prepared and used. The first results in cordierite and the second supplies the glass for maturity and then devitrifies. Compositions resulted mature from 1900° to 2450° F, with sufficient firing range, and exhibit coefficients of linear thermal expansion less than 1.88×10^{-6} in./in./°C. Author

N65-22328# Honeywell, Inc., Hopkins, Minn.
MECHANICAL AND ELECTRICAL PROPERTIES OF TiC Second Interim Technical Report
W. B. Harrison Feb. 1965 39 p refs
(Contract DA-11-022-ORD-3441)
(AROD-2884-2; AD-612253) CFSTI: $2.00

The fabrication of three grades of TiC powders, with various impurities, into high-density, fine grained, polycrystalline ceramics was studied. Metallic iron in the original powder was found to promote grain growth. The mechanical behavior of each of these materials was studied as a function of porosity, grain size, and surface finish. Normal microstructural dependencies on the transverse strength of these materials were observed. Fracture in all these materials was predominantly intergranular except where the crack path encountered large TiC crystals in the polycrystalline mass and where surface damage caused a localized influence on the crack propagation. The electrical behavior of each material was examined and attempts were made to correlate this information with the crystallographic and electronic structure of TiC and in turn the mechanical behavior observed. Author

N65-22336# Technische Hochschule München (West Germany).
THERMAL FATIGUE BEHAVIOR OF NIMONIC 80A AND PH 15-7 Mo STAINLESS STEEL Technical Report, Jul. 1960–Dec. 1962
E. Krempl and H. Neuber Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jan. 1965 74 p refs
(Contract AF 61(052)-201)
(AFML-TR-65-25; AD-460889)

The thermal fatigue behavior of Nimonic 80A and PH 15-7 Mo stainless steel was investigated. An automatic testing apparatus is briefly described. Thermal stresses are generated by direct resistance heating and constraint of the specimen. Stresses and temperature are measured and recorded as hysteresis loops, and the respective amounts of strain are calculated. The interpretation of the results for the stainless steel is complicated by the occurrence of a martensite–austenite transformation during thermal cycling, which changes the coefficient of thermal expansion by about 25%. Below the transformation temperature both materials behave similarly during thermal fatigue loading. The results indicate that thermal fatigue life is a function of the width of the first hysteresis loop regardless of test conditions. Author

N65-22356*# General Electric Co., Philadelphia, Pa.
ELECTROFORMING ALUMINUM FOR SOLAR ENERGY CONCENTRATORS
Ferenc J. Schmidt and Irving J. Hess Washington, NASA, Apr. 1965 133 p refs
(Contract NAS1-3309)
(NASA-CR-197) CFSTI: HC $4.00/MF $1.00

The possible fabrication of aluminum solar concentrators by electroforming was investigated. The three phase investigation focused on (1) determination of the basic soundness of the approach by evaluating the deposit properties from a laboratory cell; (2) scale-up of the process and building equipment to 30-in. diameter concentrator size; and (3) electroforming and testing two 30-in. diameter concentrators. In the first phase, a lithium aluminum hydride bath was chosen as the most promising electrolyte for further development. In the scale-up studies, major emphasis was placed upon parameters which affect the geometrical accuracy and surface reproduction of thin-walled electroforms. After the construction and checking out of the large scale equipment, six runs were made. Runs one through four were plagued by separation difficulties, due mainly to interlocking of the deposit with the pinholes present in the master. In run five to reduce the surface imperfections, the master was polished. Run six was separated in a vacuum chamber. Although surface marring occurred, it was demonstrated that large scale aluminum electroforming was suitable for the production of highly accurate, highly reflective, lightweight, nonmagnetic solar concentrators. S.C.W.

N65-22370*# Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Technical Progress Report, 20 Apr.–31 Dec. 1964
C. E. Couchman, III, H. S. Preiser, and A. Thiruvengadam 10 Mar. 1965 55 p refs
(Contract NAS3-4172)
(NASA-CR-54332; TPR-467-1) CFSTI: HC $3.00/MF $0.50

The operational experience in installing and calibrating a controlled environment test chamber is discussed. This experimental facility was designed specifically for conducting investigations on the cavitation damage resistance of refractory alloys in pure liquid sodium at temperatures up to 1500° F. An absolute vacuum as low as 2.5×10^{-3} torr and a leak rate as low as 10×10^{-3} torr per hour were achieved. This facility is capable of maintaining oxygen and moisture levels so as to maintain the test sodium purities less than 50 ppm of oxygen over an 8-hour period. Preliminary experiments with 316 stainless steel in 1000° F sodium show that the intensity of damage at this temperature is very much lower than that at 400° F. A modified design of the high frequency fatigue specimens was made and some preliminary experiments were conducted. A preliminary design for stress corrosion tests was made. Author

N65-22381# Naval Research Lab., Washington, D. C. Metallurgy Div.
METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Sixth Quarterly Report, Sep.–Dec. 1964
W. S. Pellini, R. J. Goode, R. W. Huber, D. G. Howe, R. W. Judy et al Dec. 1964 98 p refs
(NRL-6258; AD-612620) CFSTI: $2.25

Research studies in high strength hull structural materials are presented. Included are fracture toughness studies on (1) titanium alloys as related to processing variables (including diffusion-bonding), thickness, and heat treatment, (2) aluminum, (3) high strength steels relating primarily to the 5Ni–Cr–Mo–V steels, and (4) a nickel–beryllium alloy. Low cycle fatigue crack propagation studies on several titanium alloys are presented as well as a general review of the status of the titanium casting industry. The new 240 000 ft-lb laboratory drop-weight bulge testing facility is described and a preliminary correlation of the results obtained with it and the explosion bulge test are presented. The results of a study using fatigue cracked and side notched Charpy specimens in impact and slow bend testing on a wide variety of steels is given. The results are compared to those obtained in the standard Charpy test using the same materials. A background statement describing the philosophy of testing and evaluation of high strength structural materials is included. Author

N65-22389# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
DIFFERENCES IN FATIGUE BEHAVIOR OF SINGLE COPPER CRYSTALS AND POLYCRYSTALLINE COPPER AT ELEVATED TEMPERATURES
W. A. Wood and H. D. Nine Feb. 1965 24 p refs
(Contract Nonr-266(91))
(TR-15; AD-612713)

A comparison is made of the microstructural changes occurring in annealed polycrystalline copper and in single copper-crystals when subjected similarly to fatigue deformation by alternating torsion at temperatures ranging from room temperature to 400° C. The amplitudes of cyclic strain in each case were purposely chosen to be typical of those which at room temperature produce fatigue damage by the concentrating of slip in bands which finally turn into slip-zone microcracks. It is shown that this slip concentration in polycrystalline copper no longer occurs as the test temperature is raised and that fatigue damage instead concentrates at grain boundaries. Also the slip concentration ceases in single-crystal copper as the test temperature is raised but in this case, where there are no grain boundaries, the metal recrystallizes and becomes polycrystalline before fracture. It is shown further that whereas the fatigue life of polycrystalline copper decreases with increasing temperature that of the single-crystal copper remains unaltered. Author

N65-22428# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE PROBLEM OF THE NATURE OF THE HARDENING OF AUSTENITE STEELS
V. I. Grigorkin 18 Mar. 1965 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 2, 1963 p 95–103
(FTD-MT-64-705/1+2; AD-613160)

A study was made of the peculiarities (connected with a degree of cold hardening) of the plastic strain in austenite steels under conditions of different temperatures. The changes in the thin crystalline structure (breaking down the blocks and the formation of microstrains) and the phase situation with plastic strain separate made it possible to evaluate the action of the factors on the strength of single-phase solutions of steel of the austenite class. TAB

N65-22436# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF IMPREGNATING HIGH MELTING METALS IN A GAS MEDIUM, FOR EXAMPLE, WITH ALUMINUM, SILICON, AND ZIRCONIUM
B. N. Arzamasov and D. A. Prokoshkin 15 Feb. 1965 6 p Transl. into ENGLISH from Russian Patent no. 148318 (Appl. no. 723166/22-2), 23 Mar. 1961 2 p
(FTD-TT-64-966/1+2; AD-611421)

The object of the invention: a method of impregnating high-melting metals in a gas medium, for example with aluminum, silicon, and zirconium, with the use of a "two-story" muffleless furnace, which is distinguished by the fact that for the purpose of decreasing the consumption of gas and improving the sanitary conditions, the gas medium which is the carrier of the diffusing element of the coating onto the metal to be coated is put into circulation in a hermetically sealed space in the working chamber of the furnace and is used over and over again in the process of impregnation. TAB

N65-22449# Boeing Co., Seattle, Wash. Aero-Space Div.
MACROLAMINATE PARTICLE COMPOSITE MATERIAL DEVELOPMENT Interim Report, 1 Dec. 1964–1 Feb. 1965
F. H. Simpson and L. M. Stejskal [1965] 32 p
(Contract NOw-64-0194-f)
(IR-5; AD-457992)

Factors affecting the strength, ductility, and oxidation resistance of a microlaminate particle composite material are being investigated to ultimately develop materials for use in structural members operating in an oxidizing environment in excess of 2000° C. The material chosen is a 93.1% HfO_2–4.9% CeO_2–2% MgO–Mo composite. Particle geometry factors studied include variations in layer thickness associated with the knife coating process, the distribution of particle size fractions in the panels, and the distribution of magnesium oxide in the specimens which is probably associated with the degree of oxidation resistance. An evaluation of the effect of particle size shows that flexural strength increases with decreasing particle size, maximum oxidation resistance is obtained with specimens fabricated from −100 to +200 mesh particles, specimens made from a single particle size have better oxidation resistance but specimens made from a variety of particle sizes have higher flexural strength, and maximum deformation in compression is achieved in specimens made from −20 mesh particles. Evaluation of particle shape indicates little difference in strength between specimens made from platelike or cubical shaped particles, but rectangular shaped particles produced 40% higher flexural strength specimens than the other shapes. Forming microlaminate composites by hot pressing, isostatic pressing, and warm extrusion is discussed, and difficulties in optimizing the sintering cycle are reported. M.P.G.

N65-22462# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
METAL REMOVAL BY ELECTROCHEMICAL METHODS AND ITS EFFECTS ON MECHANICAL PROPERTIES OF METALS
John A. Gurklis 7 Jan. 1965 41 p refs
(Contract AF 33(615)-1121)
(DMIC-213; AD-613261)

Four electrochemical metal-removal (ECMR) processes—electrochemical machining (ECM), electrolytic grinding (abrasive assisted) [EG], electrochemical milling, and electropolishing—are covered. General characteristics and applications of the methods are discussed with emphasis on ECM. Although the ECMR processes generally have a neutral effect on mechanical properties, with metals whose surfaces are apt to be damaged or distorted by mechanical fabricating or finishing methods they improve mechanical properties. Because metal removal in ECMR is by anodic dissolution, there is no hydrogen entry into the metal workpiece, and loss of ductility and danger of delayed failure are not problems. Where fatigue strength is critical, use of a post-ECM or postelectropolishing finishing treatment is indicated to restore or impart compressive stresses to the surface. Factors governing surface finish and representative surface-smoothness values produced by various ECMR operations are discussed. Surface smoothness by ECM ranges from about 5- to 200-rms microinches. Similarly smooth surfaces are obtained with all the ECMR processes. The ECMR methods produce parts with surfaces free of stress, burr, thermal checks, cracks, and distortion, and surfaces with an undisturbed microstructure. Author

N65-22463# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
SUMMARY OF THE NINTH MEETING OF THE REFRACTORY COMPOSITES WORKING GROUP
E. S. Bartlett and H. R. Ogden 3 Mar. 1965 25 p refs
(Contract AF 33(615)-1121)
(DMIC-Memo-200; AD-612808)

This memorandum summarizes information on refractory materials and composites as presented at the ninth meeting of the refractory composites working group in Worcester, Massachusetts, on August 18–20, 1964. This memorandum is based on 49 papers covering a wide variety of subjects ranging from basic studies on oxidation mechanisms to the development of specific pieces of hardware. The papers are reviewed and discussed briefly within the framework of the following

four broad areas: materials technology, process technology, specific hardware applications, and evaluation techniques. Included in the section on materials technology are discussions dealing with bulk refractory materials and coated-metal systems. Hot spraying, chemical vapor deposition, powder processes, and joining are discussed in the section on process technology. The specific hardware applications cover rocket-motor components, nose caps, leading edges, and hot skins. Author

N65-22493# Westinghouse Electric Corp., Bloomfield, N. J. Lamp Div.
PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN BASE ALLOYS Technical Documentary Report, Jun. 1, 1963–Apr. 30, 1964
Heinz G. Sell, George W. King, Randolph H. Schnitzel, and N. Francis Cerulli Wright-Patterson AFB, Ohio. AF Mater. Lab., Aug. 1964 108 p refs
(Contract AF 33(657)-8247)
(WADD-TR-60-37, Pt. V; AD-613046)

Tensile properties of high purity powder metallurgy tungsten and W–1% ThO_2 alloy were determined at various strain rates and temperatures (800° to 2400° C). One percent ThO_2 imparts a slight overall increase in strength properties, although above 0.5 T_m these properties are affected by void formation. The tensile properties of pure W and W–0.35% Ta single crystals (worked, and worked and recrystallized) investigated from R.T. to 1200° C are shown to be affected by C, particularly in the quenched condition. An alloy screening program was conducted with W–25% Re, and 1% ThO_2 and 1% HFN additions, and with single crystals of W–3.5% Ta-C. The W–Re alloys have superior strength up to 2400° C. A yield stress of 47 kpsi was found at 1600° C in the quenched W–3.5% Ta–C single crystal. Reactions between ThO_2 and W, C, and several carbides were investigated as was the reaction W+TaC. A phase diagram of the W–Ta–C system resulted. Author

N65-22558*# Aerojet-General Nucleonics, San Ramon, Calif.
SNAP-8 MERCURY CORROSION AND MATERIALS RESEARCH, VOLUME III Topical Report, Jun. 1960–Dec. 1962
M. F. Parkman, B. E. Farwell, D. K. Whaley, and R. V. Arabian Sep. 1963 96 p refs *Its* Rept.-2517
(Contract NAS5-417)
(NASA-CR-62349; AN-TM-192) CFSTI: HC $3.00/MF $0.75

Mercury corrosion of Haynes Alloy No. 25, Type 405 stainless steel, AM 350, 9Cr-1Mo and Cb-1Zr thermal convection capsules was investigated between 1000 and 10000 hours at 1025° F and 1100° F and between 500 and 2000 hours at 1175° and 1250° F. Isothermal capsules of Haynes 25 and Type 405 stainless steel were operated for 5000 and 1000 hours. Thermal convection capsules were heated at the bottom and cooled at the top to create a thermal gradient of 85° to 150° F. Penetration of the bottom half of the Haynes 25 thermal convection capsules increased with time and temperature up to 2 1/2 mil maximum at 1175° F. Tensile specimens machined from the Haynes 25 capsules after test were pulled and indicated that the material age hardened after exposure at 1175° and 1250° F. Mass transfer deposits, much smaller than in Haynes 25 capsules, occurred along the top half of the Type 405 stainless steel capsules, increasing in amount with time and temperature. Author

N65-22562*# Harvey Aluminum, Torrance, Calif. Harvey Engineering Labs.
DEVELOPMENT OF ULTRA-HIGH STRENGTH, LOW DENSITY, ALUMINUM PLATE COMPOSITES Progress Report No. 16, Oct. 1–Nov. 1, 1964
E. V. Sumner 5 Nov. 1964 25 p refs
(Contract NAS8-11508)
(NASA-CR-62395; HA-2093) CFSTI: HC $1.00/MF $0.50

A high strength, low density, composite plate of aluminum alloy reinforced with steel wires for cryogenic and structural applications in space launch vehicles was developed. The effort to produce composite aluminum plate and develop methods for joining, was divided into two areas: the even distribution of the steel wire in the aluminum matrix and the bonding of aluminum to aluminum and aluminum to steel. Progress in the development of experimental methods for producing modular units of the composite plate was made. Tensile strengths of 137000 psi and 173000 psi were attained in 5456 and 2024-T62 alloy, respectively, containing approximately 25% NS355, 0.010-in. steel wire by volume. A sample of 2219 alloy with 25% 0.010-in. NS355 wire attained a tensile strength of 158000 psi, and preliminary joining samples and a 3/4 in. thick sample were produced. Design parameters for hot extruding 0.020-in. 2219 alloy were established and tooling was designed for generating hot rolling parameters. Author

N65-22635# Battelle Memorial Inst., Columbus, Ohio.
THE PROCESSING AND PROPERTIES OF HASTELLOY C
J. H. Gehrke, C. M. Jackson, and F. W. Boulger Redstone Arsenal, Ala., Army Missile Command, 28 May 1964 54 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-228; AD-461825)

Information is presented on the properties and processing characteristics of Hastelloy C, in connection with its possible utilization for the transport of gaseous oxygen (GOX) in S-1C Saturn. Topics covered include phase relationships, hardening mechanisms, physical and mechanical properties, melting procedures, procedures for primary fabrication, bending, machining, joining, degreasing, light pickling, heat-treating schedules and atmospheres, and corrosion behavior. The information was obtained from discussions with personnel of the primary producer and of nine major fabricators of Hastelloy C, from articles in technical literature, and from reports on government projects. Author

N65-22641*# General Dynamics/Astronautics, San Diego, Calif. Materials Research Group
INVESTIGATION AND ANALYSIS OF THE ELECTROPOLISHING PROCESS FOR SATURN DUCTING Final Report, 15 Mar.–31 Dec. 1962
E. W. Gross 31 Jan. 1963 82 p refs
(Contract NAS8-818)
(NASA-CR-57864; AE63-0013) CFSTI: HC $3.00/MF $0.75

Type 321 and Type 302 stainless steels and certain high-nickel alloys were electropolished in a series of formulated and vendor baths. After electropolishing, samples were subjected to investigation and analyses including salt spray, salt atmosphere, and seacoast environment corrosion tests, profilometer, and weight-loss measurement tests. The immersion and impingement methods of electropolishing were evaluated for use on propellant ducting and flexible metal hoses and sections of bellows. Electropolishing greatly increases the resistance of stainless steels to corrosion. Nine types of organic coatings were evaluated for protection of propellant ducting at cryogenic temperatures. Air-drying epoxy and acrylic formulations were found satisfactory for large assemblies that cannot be baked, and a heat curing modified silicone resin was found best for small assemblies or parts that can be baked. The impingement method of electropolishing, whereby large parts can be polished, was proven successful. Author

N65-22667# Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
MOLYBDENUM SHEET ROLLING PROGRAM Final Report
L. M. Bianchi, W. A. Mc Neish, and R. G. Mc Laughlin 22 Oct. 1964 303 p refs
(Contract NOAS-59-6142-C)
(AD-458529)

All phases of the production of arc cast molybdenum alloy sheet (Mo+0.50Ti and TZM) were studied from melting stock to final product. The study included variables in ingot size, primary fabrication by extrusion and direct forging in InFab, and secondary working over the range of warm to true hot working. Rolling studies included percent cold work, rolling temperature, intermediate annealing treatments, and surface contamination. Author

N65-22669# Stanford Univ., Calif. Dept. of Materials Science
INFLUENCE OF STACKING FAULT ENERGY ON HIGH TEMPERATURE CREEP OF PURE METALS Fourth Technical Report
Craig R. Barrett and Oleg D. Sherby 1 Jan. 1965 15 p refs
(Contract Nonr-225(60))
(SU-DMS-65-4; AD-611216)

The creep characteristics of four pure metals (Ag, Cu, Ni, and Al) with widely varying stacking fault energies were evaluated above 0.5 Tm. Creep tests were performed under conditions of constant atomic diffusivity and constant stress over the elastic modulus. The steady-state creep rate was found to be a function of the stacking fault energy such that steady-state creep rate is proportional to stacking fault energy (3.5). In addition, it was uncovered that the primary creep strain and the strain to fracture increased with increasing stacking fault energy and that the ratio of initial to steady-state creep rate decreased with increasing stacking fault energy. TAB

N65-22686# Joint Publications Research Service, Washington, D. C.
HARDENING STEELS WITH AN ELECTRON BEAM
G. T. Nazarenko 29 Apr. 1965 6 p refs Transl. into ENGLISH from Metalloved i Term. Obratotka Metal. (Moscow), no. 5, May 1964 p 56–58
(JPRS-29813; TT-65-30849) CFSTI: $1.00

Irradiation of steel samples in a vacuum led to the forming of austenite in the surface layers. Martensite transformation in austenite during cooling occurred as the result of an intensive heat transfer inside the sample. The hardening of all samples occurred in the surface layer of 0.2- to 0.3-mm thickness. The depth of the hardened layer and the distribution of microhardness depended on the conditions of irradiation, and reached a maximum microhardness of $H\mu$ 980. The structures formed by electron irradiation have a lower etchability than the structures of the base metal. G.G.

N65-22687# Joint Publications Research Service, Washington, D. C.
HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT OF METALS AND ALLOYS
Ye. N. Sokolkov and V. D. Sadovskiy 30 Apr. 1965 24 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 19, no. 2, 1965 p 226–240
(JPRS-29834; TT-65-30858) CFSTI: $1.00

High-temperature thermomechanical treatment (HTMT) was investigated as a new method of steel and alloy strengthening. The method consists of combining plastic deformation with tempering above the recrystallization temperatures while preventing recrystallization. In tests of construction alloy steels, and of austenitic steels and alloys, HTMT intensified strengthened plasticity, reduced both reversible and irreversible tempering brittleness, and increased resistance to fatigue failure. Due to the stability of the strengthened properties resulting from HTMT, the process will be useful for production of steels and alloys which can resist heat up to 650° C. J.M.D.

N65-22690# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.
FRACTURE CHARACTERISTICS OF STRUCTURAL METALS Final Report, 28 Jan. 1964–22 Jan. 1965
M. F. Amateau and E. A. Steigerwald 22 Jan. 1965 131 p refs
(Contract NOw-64-0186-c)
(ER-5937-3; AD-611873)

An examination was conducted to determine the applicability of plane strain fracture toughness values, K_{ic}, as a possible handbook design parameter. The program included: compilation of available data on plane strain fracture toughness, measurement of K_{ic} for a variety of materials to supplement existing data, evaluation of influence of test method on K_{ic}, and determination of certain processing history and section size effects on K_{ic}. Fracture toughness measurements indicated that reasonable agreement can be obtained from tests conducted with various specimen geometries. Although K_{ic} values reported from different laboratories showed considerable scatter, due presumably to variations between heats of material, definite differences in material classes could be distinguished. On this basis, K_{ic} can serve as a relative rating parameter which would aid in material selection. In addition, quantitative estimates can also be made of the load-carrying capacity of components containing possible defects. Author

N65-22695# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy
AN INVESTIGATION ON THERMAL AND MECHANICAL STABILITY OF MOLD MATERIALS FOR STEEL CASTINGS Interim Report, 28 Jun. 1963–27 Jun. 1964
Charles E. Bates and John F. Wallace [1964] 49 p refs
(Contract DA-33-019-AMC-270(Z))
(AMRA-CR-64-03/1; AD-611799)

Test apparatus and techniques were developed to measure the tensile strength of molding materials at elevated temperatures. The measurements of tensile strength obtained from this equipment permit a qualitative evaluation of the mechanical stability of the mold as molten steel enters and solidifies in the mold. The mold stability obtained with various refractory aggregate–binder combinations is a significant factor in controlling dimensional tolerances in the steel casting. Several rammed mold materials consisting of various combinations of refractory aggregates and binders were investigated for use in producing high quality steel castings. Close dimensional control of the castings was obtained with fused silica, calcined alumina and silica sand bonded with sodium silicate and green, western bentonite bonded mullite. Better casting surfaces were obtained with the fused silica aggregate. A modified sodium silicate binder utilizing silicon metal fines to promote setting was investigated. This sodium silicatesilicon fines binder combined with either fused silica or silica sand refractories provided a mold for casting steel to close dimensions with a good cast surface. Author

N65-22736 Army Materials Research Agency, Watertown, Mass.
EFFECTS OF ALLOY SEGREGATION ON SPALLING OF METALLIC ARMOR MATERIALS
K. H. Abbott *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 45–55 refs (See N65-22732 12-34)

Several illustrations of the spall crack propagation in cast and wrought metallic armor alloys were presented. Dendritic or banded structures resulting from alloy segregation during solidification of the metals were related to spall crack propagation. Neither working nor short-time homogenization treatments significantly affect the ally segregation. Hence, minimization of the banding (alloy segregation) appears to be dependent on a better understanding of, as well as control of, the solidification process. Author

N65-22738 Army Materials Research Agency, Watertown, Mass.
DENDRITIC MORPHOLOGY OF HIGH-STRENGTH STEEL CASTINGS
Paul J. Ahearn and Francis C. Quigley *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 71–84 refs (See N65-22732 12-34)

A number of important parameters associated with solidification was studied in order to establish an interrelationship between these parameters and the mechanical properties of the resulting casting. It was shown that microsegregation and dendritic size play a major role in determining mechanical properties of high-strength steel castings, and that microsegregation can be eliminated by means of 2500° F homogenization treatment. The resulting cast material exhibits mechanical properties identical to longitudinal properties of forged bar stock at the same strength level. Transverse forged properties are always inferior to longitudinal properties, thus the mechanical property superiority of this cast steel is established. Author

N65-22749 Watervliet Arsenal, N. Y.
THE EFFECT OF PRESSURE ON THE STRUCTURE AND PROPERTIES OF METAL
T. E. Davidson, J. C. Uy, and A. P. Lee *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 237–250 refs (See N65-22732 12-34)

Under certain conditions, sufficiently high hydrostatic pressures can induce localized microscopic deformation in polycrystalline metals. Examination of effects of hydrostatic pressures to 26 kilobars on several cubic metals indicated such deformation results from microscopic shear stresses arising from anisotropy in the linear compressibility. A direct relationship exists between the severity of the deformation and the degree of anisotropy. Metals exhibiting even slight deviation from total isotropy in linear compressibility will undergo such deformation if the superimposed pressure is high enough. Further, pressure cycling to 20 kilobars slightly increased the flow stress of polycrystalline zinc. The tensile strength and ductility were not affected. The ductility of magnesium, tungsten, and 1045 steel with an untempered martensitic structure was drastically enhanced by a superimposed hydrostatic pressure. E.E.B.

N65-22755 Watervliet Arsenal, N. Y.
THE RECOVERY OF THE ULTRASONIC ATTENUATION IN COPPER SINGLE CRYSTALS FOLLOWING SMALL PLASTIC DEFORMATION
Julius Frankel *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 317–332 refs (See N65-22732 12-34)

The decrease of ultrasonic attenuation in copper single crystals following small plastic deformation was studied. A pulse modulated rf signal was applied to a piezoelectric crystal mounted on a test specimen to set up sound pulses which reflect back and forth inside the specimen. The amplitude of these sound pulses was converted back into electrical energy by the crystal and applied to the input of an rf amplifier for observation of time and amplitude. The insertion loss was taken as the difference in the readings giving equal heights of the delayed and direct signals. The pulse oscillator used had a 0- to 600-volt peak to peak output and covered 0.5 to 110 Mc. The sample preparation and experimental procedures are described. It was concluded that the change in the attenuation of an ultrasonic wave in a stressed single crystal does not take place smoothly. Further, more than one recovery process is involved and the activation energy is 1.5 eV. E.E.B.

N65-22767# Battersea Coll. of Technology, London (England). Dept. of Metallurgy
USE OF REACTIVE ATMOSPHERES FOR THE TREATMENT OF B.C.C. METALS Quarterly Engineering Progress Reports, 1 Jul.–31 Dec. 1964
R. L. Samuel [1965] 6 p
(Contract N-62558-3591)
(QPR-8; QPR-9; AD-611837)

Tungsten test-pieces were sintered, both in hydrogen and hydrogen plus bromine atmospheres, using hf-heating. The test-pieces were subjected to hot bend tests, hot compression tests, and tests in sealed tubes. The tentative conclusions are reported. TAB

N65-22794# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF FRACTURE MECHANISMS, THERMAL STABILITY, AND HOT-STRENGTH PROPERTIES OF CONTROLLED POLYPHASE ALLOYS Final Report, 13 Mar. 1964–12 Mar. 1965
M. J. Salkind, B. J. Bayles, F. D. George, and W. K. Tice 12 Apr. 1965 99 p refs
(Contract NOw-64-0433-d)
(D910239-4; AD-461079)

The effect of reinforcement size on the room temperature tensile strength of Al–Al_3Ni and Al–$CuAl_2$ unidirectionally solidified composites was investigated. It was found that within the range of solidification rates studied (2 to 11 cm/hr), the reinforcement size varied by a factor of two times and no effect of reinforcement size on strength was noted. It was found that the variation of tensile strength with temperature closely parallels the behavior noted for S.A.P. A preliminary investigation of the creep behavior of Al–Al_3Ni indicates that the strain rate during the second stage of creep is comparable to that of S.A.P. although the total strain is greater. The preferred crystallography for each system persisted after long times at elevated temperatures. The microstructure of each system changed significantly only by heat treatment at relatively high temperatures. The stability of the microstructure at elevated temperature varied inversely with the solidification rate. Author

N65-22810# Brown Univ., Providence, R. I. Metals Research Lab.
SURFACE VACANCY PITS AND VACANCY DIFFUSION IN ALUMINUM
B. K. Basu and C. Elbaum Dec. 1964 20 p refs
(Contract Nonr-562(27))
(AD-611836)

The width of regions depleted of vacancy pits, near various grain boundaries, were measured in aluminum for several temperatures of pit formation. These measurements, combined with the measured temperature–time relation during pit formation, allow one to evaluate the activation energy, E_m, for vacancy diffusion. In the present study it was found that $E_m = 17 + 1$ kcal/mole for aluminum. Boundaries with

disorientation angles ranging from 2° to 50° were found to be equally effective sinks for vacancies, which indicates that this property is not sensitive to the details of boundary structure. A comparison of the pit density with the dislocation density shows that these pits do not necessarily nucleate at the intersections of dislocations with the surface. Author

N65-22845# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
REVIEW OF RECENT DEVELOPMENTS. COLUMBIUM, TANTALUM, AND MOLYBDENUM
E. S. Bartlett, F. F. Schmidt, and J. A. Houck 23 Apr. 1965 4 p refs

Recent developments in columbium, tantalum, and molybdenum technology are reported. Three areas in columbium technology are emphasized (1) development of manufacturing technology; (2) investigation of creep-rupture behavior; and (3) evaluation for superconducting applications. The development of dispersion strengthened tantalum alloys for use in advanced space power systems, and the successful extrusion of four Ta–10W and one Ta–30Cb–7.5V alloy H sections are announced. Research emphasizing techniques used in improving the forgeability of alloyed and unalloyed molybdenum is reported. S.C.W.

N65-22886# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF LIQUID SODIUM ON ENDURING STRENGTH OF STRUCTURAL MATERIALS
G. P. Dykova and V. I. Nikitin 15 Feb. 1965 12 p refs Transl. into ENGLISH from Zhidkiye Metally Sb. Statey (USSR), 1963 p 292–299
(FTD-TT-64-1210/1; AD-611424)

The durable strength in liquid sodium and in air of EI-851 steel at 700°, EI-869 alloy at 750° and EI-437 B alloy at 800° was determined. The absence of liquid metal effect on the durable strength and creep of EI-851 steel and EI-869 alloy was shown. The EI-437 B alloy revealed a reduction in durable strength and plasticity and an increase in rate of creep at all periods in a liquid metal medium. It was established that the dependence of time prior to destruction and rate of creep upon the stress applied to EI-437 B alloy in liquid metal is gradual, just as it is in air. It was shown, that the effect of liquid sodium on durable strength and creep of EI-437 B alloy at 800° is determined by the adsorption properties of the medium, the detected adsorption effect of liquid metal confirmed the mechanism of overcreeping of dislocations under creep conditions. TAB

N65-22887# Martin Co., Baltimore, Md. Research Dept.
EFFECT OF VACUUM ON THE MECHANICAL BEHAVIOR OF METALS Final Scientific Report, 1 Oct. 1963–1 Oct. 1964
I. R. Kramer, H. Shen, and S. E. Podlaseck Washington, AF Office of Sci. Res., Oct. 1964 43 p refs
(Contract AF 49(638)-946)
(AFOSR-SR-64-2509; AD-612022)

Effects of vacuum on the various mechanical properties of aluminum have been studied as a function of pressure, strain rate, crystallographic orientation, strain, specimen size and grain size. The results obtained from a series of creep, fatigue and tensile tests indicate that these parameters are intimately related to the magnitude of the effects observed in vacuum. Experimental results obtained in vacuum for the fatigue life, the coefficient of work-hardening, the change in activation energy and the activation volume are presented. The tensile properties of pure alpha iron have also been studied in vacuum, and the experimental data are presented. A theoretical surface effect model based on the concept of the "surface debris layer" is proposed to interpret all the phenomena observed in this investigation. Author

N65-22893# Aeronautical Research Labs., Melbourne (Australia).
INTERNAL NITRIDE PRECIPITATION IN CHROMIUM–TANTALUM ALLOYS DURING CREEP
N. E. Ryan Jun. 1964 12 p refs
(ARL/MET-20)

Metallographic and X-ray analysis of several chromium–tantalum alloys shows that good creep strength usually depends upon the internal precipitation of a complex chromium–tantalum nitride. This nitride results from the inward diffusion of atmospheric nitrogen during creep testing. Author

N65-22923# California Univ., Livermore. Radiation Lab.
SOME MECHANICAL PROPERTIES OF URANIUM–10 wt% MOLYBDENUM ALLOY UNDER DYNAMIC TENSION LOADS
K. G. Hoge 25 Feb. 1965 48 p refs
(Contract W-7405-ENG-48)
(UCRL-12357, Rev. 1) CFSTI: $2.00

Dynamic tensile tests were conducted on uranium–10 wt% molybdenum alloy in as-cast and wrought conditions. Carbon content was varied from 71 to 800 ppm. Heat treatment was also varied. Tests were conducted on a universal testing machine at strain rates of 4.8×10^{-5} and 0.057 in./in./sec and on a modified Dynapak at strain rates up to 100 in./in./sec. Tests were run from 75° to 600° F. Relatively low strain rates were used to determine the susceptibility to stress corrosion while the higher strain rates demonstrated the sensitivity of various mechanical properties to strain rate effects. Author

N65-22939# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
THE STRESS RELIEF OF TITANIUM WELDS FOR LOW-TEMPERATURE APPLICATIONS
R. M. Evans 26 May 1964 5 p refs
(AD-609350)

A report is presented on the desirability of stress relieving titanium alloy welds intended for low temperature applications. The use of stress relieving treatments to increase the dimensional stability of welded structures, to reduce problems in manufacturing parts to close dimensional tolerance, to reduce the possibility of premature failures, to reduce the stress level of parts subjected to elevated temperatures and chloride environments during service, and to eliminate hydride phase precipitation, is advocated. Operating temperature, design stresses, weld-metal composition, presence of stress raisers, extent of welding the structure, and weld quality, are discussed as factors to be considered when deciding whether stress relieving treatments are necessary. Stress relaxation annealing temperatures and times for commercially pure titanium and several titanium alloys are included. S.C.W.

N65-22985# Oak Ridge National Lab., Tenn. Research Materials Information Center
GROUPS IV, V, AND VI TRANSITION METALS: SELECTED REFERENCES ON PREPARATION, STRUCTURE, PHYSICAL PROPERTIES, METALLOGRAPHY, AND TRANSPORT PROPERTIES
Apr. 1965 96 p refs
(ORNL-RMIC-3 (Rev.))

An annotated bibliography is presented on the transition metals of periodic table groups IV, V, and VI. General headings for the topics are preparation methods, crystal structure, phase transitions, transport properties, and physical and mechanical properties. Specific topics include polymorphism, defects, characterization and assay methods, diffusion, electrical and thermal conductivity, heat capacity, deformation, hardness, and magnetic properties. Informative abstracts are included for most titles. J.M.D.

N65-23003*# New York Univ., N. Y.
EFFECT OF PRESSURE ON METALLURGICAL PHENOMENA Progress Report No. 9, 1 Jul.–31 Dec. 1964
[1964] 12 p refs
(Grant NsG-90-60)
(NASA-CR-62542) CFSTI: HC $1.00/MF $0.50

The temperature–composition diagram at atmospheric pressure was studied for 26 thallium–lead alloys in the range from 1 to 40 atomic percent lead. These alloys were processed into 0.060-inch diameter wire for which the resistivity was measured as a function of temperature. The effect of lead additions was to lower the temperature of the transition from the structure of pure thallium to that of a body-centered-cubic beta structure. Further, a eutectoid reaction was suggested at about 180° C with a composition of 4.2 atomic percent lead. Also, the resistivity and Seebeck coefficient were measured as a function of temperature at different pressures for PbTe and SnTe. Temperatures were varied by using double concentric graphite furnaces. Shorts were developed at high pressures between the leads of the two furnaces and the thermocouple wires. Due to this shorting, the results did not span the full pressure range of the equipment. Log p vs 1/T at various pressures are given. E.E.B.

N65-23101# Los Alamos Scientific Lab., N. Mex.
THE FORMING AND EVALUATION OF UO_2 AGGLOMERATES FOR CERMET APPLICATIONS
William H. Lenz and Marvin C. Tinkle 7 Apr. 1965 45 p refs
(Contract W-7405-ENG-36)
(LA-3232-MS) CFSTI: $2.00

The formation of spheroidal UO_2 agglomerates was investigated with a view toward application in refractory metal cermets. Essentially the selected process consisted of compacting a mass of fine UO_2 powder, crushing the compact to the desired screen sizes, and spheroidizing the crushed fragments by mechanical abrasion. Spheroidizing was attempted by combining shaking, rolling, or vibratory motion with conventional screens or abrasive surfaces. The crushed particles covered an extensive hardness range which was reflected in the results obtained. Evaluation of the various products was accomplished by microscopic inspection, porosimetry, chemical analysis, and by sintering blends made with refractory metal powders. The experimental products were also compared in various ways with similar commercial materials and with UO_2 agglomerates furnished by another laboratory. Author

N65-23103# Argonne National Lab., Ill. Metallurgy Div.
CORROSION OF EXPERIMENTAL THORIUM-BASE ALLOYS
James Y. N. Wang Feb. 1965 13 p refs
(Contract W-31-109-ENG-38)
(ANL-7006) CFSTI: $1.00

Some 50 high-purity, binary and ternary, thorium-base alloys were prepared and corrosion tested in distilled water between 120° and 260° C. Data indicated that the addition of titanium improved corrosion life of Th–1 wt% C and Th–0.5 wt% C binary alloys at 260° C. Additions of aluminum from 3 to 7 wt% appeared beneficial. At 200° C, a Th–10 wt% Y alloy exhibited a low corrosion rate during a short period of exposure. The corrosion resistance of all thorium–uranium alloys in increments of 5 wt% uranium, to the maximum 40 wt% uranium, was poor. The addition of 4 wt% zirconium to Th–15 wt% U caused an improvement at 200° C. Author

N65-23121# Stanford Univ., Calif. Dept. of Materials Science
DISLOCATION STRUCTURE OBSERVATIONS AT LUDERS FRONTS IN TANTALUM Technical Report No. 12
Troy W. Barbee, Jr. and Robert A. Huggins Jan. 1965 28 p refs
(Contract Nonr-225(34))
(SU-DMS-65-1; AD-612194)

Dislocation configurations at Lüders fronts in tantalum which deformed by nonuniform discontinuous yielding were examined. No contrast structure was observed in grain boundaries of recrystallized material unless evidence of sample mishandling or incomplete recrystallization was observed. No classical pileups were seen although slip bands were found in regions just ahead of a Lüders band. Dislocation source action at or near grain boundaries was observed at Lüders fronts and within Lüders bands. The dislocation density was observed to increase during the passage of a Lüders front, and grain boundaries were seen to rapidly develop contrast structure during the passage of a Lüders front. These observations are discussed in light of current knowledge concerning the mechanism of discontinuous yielding. Author

N65-23125# Dow Chemical Co., Denver, Colo. Rocky Flats Div.
DELTA STABILIZED TERNARY ALLOYS OF PLUTONIUM
J. E. Fuller 22 Apr. 1965 24 p refs
(Contract AT(29-1)-1106)
(RFP-506) CFSTI: $0.50

A preliminary survey of the plutonium-rich corners of the Pu–Al–Ga, Pu–Zn–Ga and Pu–Ce–Ga systems was made. Emphasis was on the determination of how well the delta phase of plutonium was stabilized by these alloy additions. Author

N65-23129# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy
CONTROL OF CAST GRAIN SIZE OF STEEL CASTINGS Interim Report, Aug. 16, 1963–Aug. 15, 1964
P. Wieser, N. Church, and J. F. Wallace [1964] 90 p refs
(Contract DA-33-019-AMC-273(Z))
(AMRA-CR-64-04/1; AD-611800)

Techniques for the quantative evaluation of refinement of a high strength cast steel were evolved and used to test the effectiveness of various inoculants in achieving microstructural and macrostructural refinement. Of the various materials tested only titanium additions produced significant refinement of both the micro- and macrostructure. Comparison of the tensile properties of the basic steel with that of a refined steel shows that large additions (0.2 to 0.6 wt%) of titanium are sufficient to decrease the reduction in area sharply. Further data on castings partially refined with small (0.10 wt%) titanium additions indicate than an improvement in reduction of area is obtained compared to the results with a columnar structure solidified under similar thermal conditions. Author

N65-23168*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OBSERVATIONS OF INTERNAL OXIDATION IN SIX NICKEL-BASE ALLOY SYSTEMS

James S. Wolf, John W. Weeton, and John C. Freche Washington, NASA, May 1965 60 p refs
(NASA-TN-D-2813) CFSTI: HC $3.00/MF $0.50

An internal oxidation investigation was conducted with a series of solid-solution nickel-base binary alloys (nickel (Ni) with aluminum (Al), magnesium (Mg), silicon (Si), titanium (Ti), chromium (Cr), and manganese (Mn)). These systems were studied to determine their potentials as dispersion-strengthened materials and to gain some additional insight into methods whereby the internal oxidation approach may be utilized to create improved aerospace materials. The alloys were air oxidized for 200 hours at 1200°, 1500°, and 1800° F and were then subsequently stability annealed in vacuum for 24 hours at 2000° F. The major results were as follows: (1) Subscale penetration increased with decreasing solute concentration and increasing oxidation temperature. (2) External scales decomposed during the stability anneal and provided a source of oxygen that caused further oxide penetration into the specimens; (3) The stability anneals, subsequent to the higher temperature oxidation treatments, promoted only minor changes in the size and shape of existing internal oxides. (4) The subscale morphology differed among the different systems and included small, closely spaced particles (Ni–Mg), highly oriented acicular particles (Ni–Al), and large, widely spaced angular oxides (Ni–Cr and Ni–Mn). (5) Based on optical microscopy, two alloys (Ni–1.32 atomic percent Mg and Ni–0.98 atomic percent Si) appeared to be particularly amenable for application as dispersion-strengthened materials. Author

N65-23197*# Hughes Aircraft Co., Culver City, Calif. Materials Technology Dept.
STUDY OF ADHESION AND COHESION IN VACUUM Fifth Quarterly Report, 1 Oct. 1964–1 Jan. 1965
P. M. Winslow, D. Horowitz, and D. V. Mc Intyre 1 Jan. 1965 20 p
(Contract NAS8-11066)
(NASA-CR-62595; PG5-03) CFSTI: HC $1.00/MF $0.50

Adhesion and cohesion tests made under static loading conditions in vacuum showed no tendency for 2014 aluminum alloy to bond to itself or the other test materials when loaded within its elastic limit at 150° C. Bonding of these material couples generally occurred at 300° C in vacuum. It was also determined that 2014 aluminum would bond to itself in air in the same period of time and under the same load as it bonded in vacuum. The strengths of the vacuum-bonded specimens appeared higher. Cohesion of copper did not occur in vacuum at 150° but did occur at 300° C. There was no indication of cohesion of the titanium alloy couple tested at 500° C. The equipment design modification for incorporating vibratory motion to the test specimens was completed. The drive mechanism was designed and built. Author

N65-23218# Syracuse Univ. Research Inst., N. Y.
AEROSPACE STRUCTURAL METALS HANDBOOK. VOLUME I: FERROUS ALLOYS
V. Weiss and J. G. Sessler, ed. Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 182 p refs
(Contract AF 33(616)-7792)
(ASD-TDR-63-741; Vol. I; AD-611196)

The *Aerospace Structural Metals Handbook*, with the insertion of the first revision packet of 17 new alloy chapters, now contains physical, chemical, and mechanical property information on 155 metals and alloys of interest for aerospace structural applications. The Handbook consists of two volumes: Volume I, *Ferrous Alloys*, and Volume II, *Non-Ferrous Alloys*, each volume self-contained in a looseleaf, standard 3-post binder. Volume I contains 60 ferrous alloy chapters and Volume II contains 95 nonferrous alloy chapters. Major revision and updating has been applied to 8 of the existing alloy chapters. Further periodic revision and updating of alloy chapters are planned. The Handbook also contains data source references, a general discussion of properties, a glossary of terms, a discussion of fracture toughness, and a cross index of alloys contained therein. Author

N65-23248# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
CHEMICAL MILLING OF H-11 STEEL, 260–280 KSI
Christian J. Staebler, Jr. Oct. 1964 28 p refs
(ADR-08-06-64.3)

The object was to determine the operating parameters for chem-milling H-11 steel in the 260 to 280 ksi range. Two other objectives were to determined the degree of hydrogen pickup caused by chemical milling, and to determine the best method of eliminating or minimizing any embrittlement effects. The data indicate the feasibility of chem-milling process for H-11 steel in a 10% H_2SO_4–7% HNO_3 bath in the 260 to 280 ksi range. Results of the hydrogen embrittlement study are also included. Author

N65-23259# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
EFFECT OF COLD FORMING ON THE FATIGUE PROPERTIES OF HY-80 STEEL PLATES Progress Report
R. P. Haak and S. T. Rolfe 2 Jan. 1964 31 p refs
(Contract NObs-88540)
(S-13202-2; AD-429446)

Because the cold forming of submarine-hull plates can significantly alter their mechanical properties, a study was initiated to determine the effect of cold deformation on the mechanical properties of 2 1/2-inch-thick plates of HY-80 steel cold-formed to small radii and consequently to large surface strains. This report describes the results of a limited investigation to determine the effects of cold deformation and subsequent stress relieving or aging on the rotating-beam fatigue properties of HY-80 steel. The tests were run to determine whether sufficient variation in the low-cycle fatigue lives existed to warrant an extensive investigation of the effects of cold forming on the fatigue properties of HY-80 steel. The results indicated that no large changes took place in the rotating-beam fatigue lives of specimens that had been previously cold-deformed in tension or compression or of specimens that had been cold-deformed and subsequently stress-relieved or aged, especially when compared with expected changes in fatigue life resulting from notches, flaws, etc. Thus the effects of cold deformation on the rotating-beam fatigue behavior of HY-80 steel were relatively minor. Author

N65-23262# Battelle Memorial Inst., Columbus, Ohio.
FURTHER DEVELOPMENT OF A DUCTILE TUNGSTEN-BASE SHEET ALLOY Quarterly Progress Report, 19 Aug.–19 Nov. 1964
J. L. Ratliff, W. H. Abbott, D. J. Maykuth, H. R. Ogden, J. M. Blocher, Jr. et al 19 Dec. 1964 22 p refs
(Contract N600(19)-61982)
(QPR-2; AD-454869)

Processing studies were conducted to develop new and improved ways of accomplishing ThO_2 dispersion in W-5Re-2.2ThO_2. Promising results which indicated improvements in ductility over the standard nitrate preparation were obtained by preparing the alloy from a ThO_2 sol. Fractographic studies were conducted on a tensile specimen of W–5Re–2.2 ThO_2 which showed 12% elongation when tested at 0° C. Results indicate that the tensile ductility was derived from inhibited crack propagation. Author

N65-23263# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
THE EFFECTS OF TEMPERED NONMARTENSITIC PRODUCTS ON THE NOTCH TOUGHNESS AND MECHANICAL PROPERTIES OF AN HY-80 STEEL
A. R. Willner and M. L. Salive Jan. 1965 62 p refs
(DTMB-1605; AD-611407)

This report discusses the effects of nonmartensitic products and mechanical properties on the nil-ductility-transition (NDT) temperature and transverse Charpy V-notch absorption level, for a selected HY-80 steel. Proeutectoid ferrite was found to have the most detrimental effect on the transverse Charpy maximum energy level. Large prior austenitic grain size, irrespective of microstructure, increases the NDT temperature by approximately 100° F. It is recommended that the present HY-80 specification be amended to require two chemistry ranges, one for thin and one for thick plates. Author

N65-23264# International Lead Zinc Research Organization, New York.
ILZRO RESEARCH DIGEST NO. 15, OCTOBER 1, 1964 TO APRIL 1, 1965. PART IV: LEAD METALLURGY
1 Apr. 1965 42 p refs

The articles on lead technology reviewed include the following: asbestos pads for vibration attenuation, sound attenuation, plumbing, continuous sheet lead casting, roofing, acoustical use in European building partitions, flame spraying of low-temperature porcelain enamels, concrete coatings, conversion of particulate lead to wrought forms, composite cable sheathing, metal fiber reinforcement, adhesive joining of lead, plating on steel, power metallurgy, lead acid batteries, joining of particulate lead products, corrosion, fatigue cracking, properties of molten lead and lead alloys, fatigue stress and surface reactions of lead, dynamic properties of lead and lead alloys, and surface reactions of lead. Also, completed programs and articles, and presentations by the staff and contractors are included. E.E.B.

N65-23267# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
METALWORKING Review of Recent Developments
J. H. Gehrke and F. W. Boulger 30 Apr. 1965 3 p refs

Recent developments in forging and extrusion processes are reviewed. Among the specific items discussed were the properties of Ti–6Al–4V alloy forged at different temperatures, solution treated 1 hour at 1725° F, water quenched, and then aged 1 hour at 1025° F. Tensile strength, area reduction, and elongation are shown. Also, the tensile properties of 1100-0 aluminum after extrusion at high and low ram speeds to a reduction ratio of 25:1 are given. Tensile strength, yield strength, and elongation are reported for ram speeds initially of 34 ft/sec and a constant speed of 0.5 inch/minute. Further, an illustration is given of patterns of metal flow contributing to shear cracks in forged ribs. E.E.B.

N65-23318# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
STATUS OF TITANIUM CASTINGS
J. G. Kura 7 Oct. 1964 3 p ref
(AD-609354)

The state of the art in titanium castings is reviewed. Also, the tentative specifications for titanium and titanium alloy castings are given for Brinnell hardness, ultimate tensile strength, yield strength, and elongation. Further, a casting of the Ti–5Al–2.5Sn alloy with 178 000-psi ultimate tensile strength, 158 000-psi yield strength, and 11% elongation at liquid hydrogen temperatures is reported. The state of the art has not developed to the point where precision castings of titanium are comparable with conventional metals cast in investment molds. Molten titanium is too reactive to be cast in these molds. However, the capability does exist for the production of high quality castings. E.E.B.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-22286 Army Natick Labs., Mass.
HIGH SPEED PENETRATION OF NON-WOVEN FABRICS
Roy C. Laible *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 137–151 refs (See N65-22275 12-34)

High speed photography was used to follow the missile–target interaction with time, and laboratory tests were conducted to study stress–strain properties of felts in order to determine the reasons for the good ballistic resistance of felts. The major target material for the ballistic studies was a needle-punched nylon felt with the following characteristics: 3-in. staple length, 0.1-in. thickness, 1.87 oz/sq ft areal density, and 6-denier nylon tire cord fiber. High speed penetration tests were conducted at 6000 in./min. Also, the thin needle-punched nylon felt was subjected to impact by the 0.22 caliber 17-grain fragment simulator at velocities from 640 ft/sec to 700 ft/sec, near the V_{50} value. Further, the results of tensile tests at two rates of testing were tabulated for the 0.1-inch felt at breaking strength, elongation, and estimated work to rupture. The nylon felt was found to have an elongation at break of 85% at 300%/min and 79% at 300 000%/min, whereas nylon fabric exhibits an elongation of about 30% even at static speeds. The major reason for the excellent behavior of felts was demonstrated by the tensile stress–strain behavior at different rates of strain. E.E.B.

N65-22291 Army Missile Command, Huntsville, Ala.
EFFECT OF FILLER CONCENTRATION ON THE VISCOELASTIC RESPONSE OF A FILLED POLYMER SYSTEM
Donald L. Martin, Jr. *In* Army Dept. Army Sci. Conf. Proc., Vol. II, [1965] p 211–226 refs (See N65-22275 12-34)

The effect of volume fraction of filler particles on various mechanical properties of the PBAA propellant system was determined. Five compositions of the PBAA polymeric system were prepared with filler fractions of 0%, 21%, 42%, 63%, and 84% using the same lot of raw materials. All compositions were cured at 140° F for 84 hours. Maximum stress, modulus, strain energy density, and strain capacity for these compositions are reported. These experimental data showed that the addition of filler to the PBAA polymeric system increased the maximum stress, modulus, strain energy density, and stress–strain properties, with a corresponding decrease in the strain capacity. Further, the data presented make it possible to estimate the mechanical response of the PBAA propellant system at any desired strain rate, temperature, and filler fraction within the applicable time spectrum. E.E.B.

N65-22292 Army Engineer Waterways Experiment Station, Vicksburg, Miss.
THE STRENGTH OF PORTLAND-CEMENT CONCRETE AS AFFECTED BY AIR, WATER, AND CEMENT CONTENT

Bryant Mather *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 227–232 (See N65-22275 12-34)

Three concrete mixtures of different cement content were proportioned without the use of an air-entraining admixture. Each of these mixtures was then modified by the introduction of an air-entraining admixture in appropriately increasing amounts to cause entrained air contents of varying amounts up to 12%. In modifying each admixture, the cement content, the coarse aggregate content, the mortar content, and the workability were kept constant by removing water and fine aggregate as air was added. It was found that the ratio of water to fine aggregate did not change with changes in air content but did change linearly with change in cement content. Further, analysis of the data suggested that for a concrete mixture containing about 310 pounds of cement per cubic yard the air content could be changed without changing the strength. For richer mixtures the strength would tend to be reduced as the air content was increased, and for leaner mixtures the strength would tend to be increased as the air content was raised. E.E.B.

N65-22324# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics

CRACK EXTENSION IN FIBERGLASS REINFORCED PLASTICS

Edward M. Wu and R. C. Reuter, Jr. Feb. 1965 32 p refs
(Contract NOw-64-0178-d)
(T&AM-275; AD-613576)

Experimental investigation on initially cracked scotchply plates indicated that the fracture strength of this fiberglass reinforced plastic can be described by the laws of linear elastic fracture mechanics. The stress intensity factors, K_{1c} and K_{2c}, were constants for symmetric and skew-symmetric loadings. Furthermore, K_1 and K_2 were also found to be constants for various combinations of symmetric and skew-symmetric loadings. As indicated by photographs of the fractured specimens and the crack displacement time curves it was observed that although the cracks propagated along lines which were essentially straight, it is probable that the cracks made microscopic skips across the fiberglass reinforcement in the vicinity of this line in a discontinuous manner. This phenomena occurs more frequently when the specimens are subjected to shearing stress. At present, because the modes of crack extension under different type of loading are not fully understood, and also due to the mathematical difficulties involved in the calculation of maximum normal stress, maximum shear stress and maximum energy release rate, a general law of fracture applicable to all orthotropic materials cannot be formulated without further analytical and experimental investigations. An empirical equation was found which was an adequate representation for balsa wood as well as scotch-ply and could represent a general fracture law for orthotropic materials. TAB

N65-22353*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EFFECTS OF NUCLEAR RADIATION, CRYOGENIC TEMPERATURE, AND VACUUM ON THE ELECTRICAL PROPERTIES OF DIELECTRIC MATERIALS

R. L. Gause and E. C. Mc Kannan 30 Mar. 1965 34 p ref
(NASA-TM-X-53230) CFSTI: HC $2.00/MF $0.50

Commonly used dielectric materials were evaluated to determine their response to environmental parameters such as neutron and gamma radiation to 1.7×10^{10} ergs-gm^{-1} (C), cryogenic temperatures to $-160°$ C, and low pressures to 2×10^{7} mm Hg, simultaneously. The data which were obtained included capacitance (k), dissipation factor (tan σ), and mechanical properties. The dissipation factor data are not discussed because no significant changes were measured. The electrical measuring techniques employed for obtaining valid and reproducible information from combined environmental tests are discussed, and the test equipment is described. A preliminary evaluation is made of four dielectric materials: fluorocarbon, polyurethane, epoxy, and silicone. The results indicate that low pressure alone has little or no effect on k where the polymers are thermally stable, radiation alone increase k, and temperature in the range $+70°$ C to $-160°$ C has little or no effect on k of the silicone and fluorocarbon, but it has a direct and significant effect on the epoxy and polyurethane. The mechanical strength of the four polymers is reasonably stable when they are irradiated in vacuum at cryogenic temperatures. Author

N65-22354*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ACCELERATED COMPRESSION SET PROPERTIES OF FOURTEEN ELASTOMERS

C. D. Hooper and J. T. Schell 2 Apr. 1965 49 p
(NASA-TM-X-53232) CFSTI: HC $2.00/MF $0.50

Fourteen types of synthetic elastomers, from which O-rings and other gaskets might be fabricated, were investigated for their compression set properties. Each compound was tested at a minimum of three temperatures [ranging from 70° C (158° F) to 250° C (482° F)] during various periods of time up to 32 days. Results showed that most elastomers have reasonably good compression set properties at room temperature (25° C) but that many of these might have critical limitations when subjected to the same compression at an elevated temperature. These tests were not expected to indicate the small differences that might be encountered in actual service; however, they do provide a practical evaluation of the properties that are useful where a high degree of precision is not expected. A summary of the data obtained is presented in graphical form, illustrating the characteristics and limitations of each compound tested. Author

N65-22357*# General Electric Co., Philadelphia, Pa.

EVALUATIONS OF FILAMENT-REINFORCED COMPOSITES FOR AEROSPACE STRUCTURAL APPLICATIONS

Norris F. Dow and B. Walter Rosen Washington, NASA, Apr. 1965 184 p refs
(Contract NASw-817)
(NASA-CR-207) CFSTI: HC $5.00/MF $1.25

Studies of the influence of constituent properties upon the performance of structural composites for aerospace applications are described. Previous elastic constant and tensile strength evaluations are extended to broaden their range of applicability. An analysis of compressive strength is presented. These analyses are then used in a structural efficiency study of sandwich cylindrical shells subjected to axial load conditions appropriate to the launch vehicle problem. Author

N65-22411* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYNTHETIC ZEOLITES: THEIR DERIVATION, RESEARCH AND USE Selected Articles

12 Feb. 1965 18 p refs Transl. into ENGLISH from the Russian publ., Moscow, Akad. Nauk SSSR Press, 1962 p 218–224
(FTD-MT-64-451; AD-612369)

CONTENTS:

1. ADSORPTION OF MIXTURE OF THIOPHENE AND HEPTANE ON ZEOLITE NAA A. V. Kiselev, Yu. A. El'tekov, and V. N. Semenova p 1–10 refs

2. USE OF SYNTHETIC ZEOLITE CAA FOR SEPARATION OF MIXTURES OF HYDROCARBONS M. B. Vol'f and R. V. Alekseyeva p 11–14

N65-22442* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASTIC FRICTION DISKS
A. Os'machko, V. Luganskaya, and Yu. Yegerev 24 Mar. 1965 6 p Transl. into ENGLISH from Mashinostr. (Kiev), no. 12, 1960 p 36-37
(FTD-TT-64-1180/1; AD-613453)

The article describes plastic friction disks for electromagnetic couplings. The friction material consists of 22% fibrous asbestos, 14% carborundum, 15% silver graphite, 5% tin in powder and 44% of polyester resin solution. TAB

N65-22469# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
THE EFFECTS OF REACTOR RADIATION ON THE PHYSICAL PROPERTIES OF TWO RADIATION-RESISTANT O-RING COMPOUNDS Final Report, 1 Oct. 1963-30 Sep. 1964
J. H. Lewis, P. M. Johnson, and M. R. Self Kirtland AFB, N. Mex., AF Weapons Lab., Jan. 1965 83 p refs
(Contract AF 29(601)-6213)
(FZK-196; WL-TR-64-133; AD-612604)

Two O-ring compounds specially formulated for radiation resistance—PRPC 1387 (NBR) and PRPC 4387 (SBR)—were irradiated to six gamma dose levels in the range of from 4.9×10^8 to 1.5×10^{11} ergs/gm(C). The O-rings, tensile specimens, and compression-set buttons of both materials were irradiated in air at (or near) room temperature. The O-rings of PRPC 1387 were also irradiated in oil. Tensile properties, hardness, compression set, weight change, and specific gravity were measured as a function of radiation dose. Several analytical procedures were used in interpreting the data. The wide range of doses employed in the experiment provides an accurate assessment of degradation produced by radiation. The highest dose resulted in complete loss of useful mechanical properties. The properties most adversely affected at lower doses were ultimate elongation, hardness, and compression set. However, both materials exhibit good radiation resistance and appear to be useful up to doses of at least 10^{10} ergs/gm(C). Author

N65-22483# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics
AN INVESTIGATION INTO THE EFFECT OF ENVIRONMENTAL TREATMENTS ON THE STRENGTH OF E-GLASS FIBRES
N. M. Cameron Jan. 1965 164 p refs
(Contract NOw-64-0178-d)
(T&AM-274; AD-456850)

Various experiments were carried out to determine the effects of certain environmental treatments on the load carrying capacity of virgin glass fibers. The state of the fiber surface, during and after environmental treatments, with the tensile strength used as a characteristic measure of state was also examined. The effect of strain rate on strength was also studied in the range 0.01 in/in/min to 10 in/in/min. Fiber strength in vacuum was found to increase with time. Subsequent envelopment in dry nitrogen gas at atmospheric pressure and at room temperature did not influence the observed strength, but at nitrogen gas temperature below room temperature a strength resulted which was a function of both the temperature and the time of prior evacuation. Maximum value was reached at liquid nitrogen temperature. The standing of fiber samples in air decreased their strength; heating of stressed and stress-free fiber specimens led to large reductions in strength as the heating temperature was raised. G.G.

N65-22484# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
STORAGE STABILITY OF BRAKE FLUIDS Final Report
C. B. Jordan 23 Feb. 1965 10 p refs
(CCL-176; AD-458510)

The stability of corrosion inhibiting systems found in brake fluids after extended storage of the fluids in steel and glass containers was investigated. Corrosion and oxidation stability tests were conducted on 22 approved fluids after 2 1/2 years storage in 5-gallon steel containers and on 8 approved fluids after 5 years storage in 1-gallon glass containers. In all tests conducted there was evidence of inhibitor instability or depletion. Sixteen of the 22 fluids stored in cans and 5 of the 8 fluids stored in glass failed to meet minimum requirements of specification. Author

N65-22527# Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
ON A GENERAL THEORY OF VISCOELASTICITY
L. R. Herrmann Mar. 1964 24 p refs *Its* Technical Paper No. 133 SRP

The constitutive law governing the behavior of a viscoelastic solid is developed from energy considerations. The law is applicable to all continuous materials that are capable of experiencing instantaneous deformations (as a result of loads of finite magnitudes) and are not capable of instantaneous energy dissipation. The particular examples of linear and second-order constitutive equations are examined in detail. The effect of material symmetry, in the undeformed state, is considered and the explicit forms of the equations for an isotropic material are developed. Author

N65-22682# Pennsylvania State Univ., University Park. Graduate School
AN EPR INVESTIGATION OF RADIATION PROTECTION BY AROMATIC ADDITIVES IN SYNTHETIC POLYMERS
Jerome J. Banaszak (M.S. Thesis) Dec. 1964 75 p refs
(Contract AF 33(608)-954)
(AD-511779)

The research is a study of the protective effects against ionizing radiation that aromatic compounds provide when added to a synthetic polymer in various proportions. Since radiation damage in high-polymer compounds is usually accompanied by the production of free radicals in the material, electron paramagnetic resonance (EPR) techniques were utilized to measure the extent of the free radical concentration. Comparative measurements were made of the radiation-protective effects of different aromatic additives on polymethyl methacrylate. Data obtained from the EPR spectra were correlated with some of the theories currently advanced relating free radical formation, degradation, and crosslinking during polymer irradiation. Degradation, or multiple chain scission, is defined as the breaking up of the long molecular chains in a polymer into smaller units, whereas crosslinking is usually associated with increasing the number of lateral linkage between polymer chains. TAB

N65-22795# Naval Ordnance Lab., White Oak, Md.
THE COMPRESSIBILITY OF CROSSLINKED POLYMERS
Robert W. Warfield 18 Feb. 1965 31 p 28 refs
(NOLTR-64-243; AD-460483)

Bulk compressibilities of a series of cross-linked polymers were measured at pressures up to 10000 atmospheres and over the temperature range of 25° to 250° C. These polymers exhibited nonlinear compressibility characteristics reaching a maximum compressibility of about 15% at 10000 atmospheres, and decreasing with increasing pressure. By conducting the measurements at slow speeds, data were obtained which could

be expressed as glass–rubber phase diagrams. The nature of the observed compressibilities is discussed, and the variation of the glass transition with pressure is analyzed on the basis of Ehrenfest thermodynamics. Author

N65-22920*# Rocketdyne, Canoga Park, Calif.
THERMAL INSULATIVE ELASTOMERS FOR CLUSTERED LARGE LIQUID PROPELLANT ROCKET ENGINES
S. T. Peters 21 May 1964 39 p refs Presented at the 7th Natl. SAMPE Symp., El Segundo, Calif. 20–22 May 1964
(Contract NASw-16)
(NASA-CR-62836) CFSTI: HC $2.00/MF $0.50

As thrust levels increase and as rocket engines fire for longer periods of time, the difficulties encountered in the protection of critical components from the effects of excessively high temperatures greatly increase. To protect these components a series of filled elastomeric composites were evaluated. A brief discussion is presented of the problems of hot gas recirculation, radiation, and base plane heating with particular reference to large, clustered, liquid propellant rocket engines. The effect on components is discussed and an evaluation of a series of insulators based on filled elastomeric composites is presented. The evaluations are based on specialized thermal tests which were designed to simulate as far as possible, conditions during flight. The most promising of these elastomeric composites are compared to three alternative insulative systems, a filled, castable ceramic, a metal foil-silica fiber batting, and an asbestos-inconel wire mesh composite, in terms of weight, cost, and ease of fabrication and repair. Author

N65-23013# College of Aeronautics, Cranfield (England). Dept. of Materials
CHARACTERISTICS OF THE HIGH TEMPERATURE MECHANISMS OF CREEP AND RECOVERY IN GRAPHITE Final Technical Report No. 1, Aug. 1, 1963–Jul. 31, 1964
Feb. 1965 18 p refs
(Contract DA-91-591-EUC-2880)
(CoA-NOTE-MAT-1, Pt. IV)

Work on the torsional creep and recovery properties of graphites in the temperature range 2000° to 3000° C continued. Differences in the steady-state creep behavior were noted between extruded and pressed grades, in the latter no steady-state component being observed. In creep tests on ungraphitized extruded material after given soaking times above 2000° C, it was shown that the time at temperature influenced the initial elongation but had relatively little effect on the creep rate. Rates and amounts of recovery were, however, both reduced by increasing heat-treatment time. Author

N65-23092# United States Polymeric Chemicals, Inc., Santa Ana, Calif.
DEVELOPMENT AND EVALUATION OF IMPROVED RESINS FOR FILAMENT WOUND PLASTICS Quarterly Report, 31 May 1964–31 Jan. 1965
T. F. Downey 31 Dec. 1964 24 p Sponsored by Navy Dept.
(QR-3; QR-4; AD-612085)

This report describes the most recent research and development in the field of filament products. Technical activity includes new resin evaluation, synthesis of new polymers, with subsequent impregnating and testing, new product development and improvement. Fields of application for these products range from ablative filament winding products, high temperature resistant and high strength prepregs to high strength material for deep submergence applications, and high strength structural unidirectional tape material. Author

N65-23098# American Oil Co., Whiting, Ind. Research and Development Dept.
DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUID Bimonthly Progress Report, Dec. 1, 1964–Feb. 1, 1965
[1965] 10 p
(Contract Nobs-90267)
(BMPR-5; AD-611396)

The object is the development of a water-base hydraulic fluid which yields a fire-resistant nonaqueous residue, is compatible with materials of constructon and sea-water contamination, satisfactorily lubricates shipboard pumps, presents no unusual storage or handling problems, and exhibits no toxicological hazards under conditions of use. Low-density polyethylene can be chlorophosphonated by reaction with phosphorus trichloride and oxygen. Hydrolysis and neutralization produces products which show considerable promise as thickeners. Fluids prepared from products from 21 000-molecular-weight polyethylene have been found to exhibit undesirable viscosity, instability, and high wear in Vickers Vane pumps. Viscosity instability is much less pronounced when 12 000-molecular-weight polymer is used to prepare the thickeners and 18% of potassium ethane phosphonate, added as a pour depressor, is present. High pump wear, however, is still a problem. Work on the development of an antiwear additive has begun. Flammability characteristics and compatibility with materials of construction and 10% sea water do not appear to be problems with these fluids. Attempts to prepare polymers of unsaturated organic acids of phosphorus having molecular weights sufficiently high to thicken water have been discontinued. Author

N65-23288*# Stanford Research Inst., Menlo Park, Calif.
MECHANICAL PROPERTIES OF CROSSLINKED POLY-(METHYL METHACRYLATE) POLYMERS UNDER SPACE ENVIRONMENTAL CONDITIONS Quarterly Technical Summary Report No. 6, 1 Dec. 1964–28 Feb. 1965
N. W. Tschoegl and J. E. Frederick [1965] 21 p refs
(Contract NASr-49(13))
(NASA-CR-62646) CFSTI: HC $1.00/MF $0.50

The objective of this study of crosslinked poly(methyl methacrylate) (PMMA) polymers is to obtain information on the behavior of crosslinked polymers in space environments. Of particular interest are the degradative changes in structure which take place in vacuo at elevated temperatures, the kinetics associated with the degradation process, and the influence of the degradative changes on the mechanical properties of the polymer. Tensile stress–strain data were obtained on new samples at 165° and 185° C, and a new computer program was written to analyze these data. The continuous and intermittent stress relaxation was measured on uncrosslinked PMMA and on two of the more highly crosslinked samples at temperatures between about 170° and 225° C, both in air and in vacuum. To obtain an estimate of the degree of crosslinking and to characterize further the samples, swelling measurements were carried out in two solvents. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-22213# Research Triangle Inst., Durham, N. C.
THE MOMENTS OF THE NUMBER OF CROSSINGS OF A LEVEL BY A STATIONARY NORMAL PROCESS Technical Report No. 3

Harald Cramer and M. R. Leadbetter Feb. 1965 14 p refs
(Contract Nonr-4565(00))
(SU-181; AD-611314)

The number N of upcrossings of a level u by a stationary normal process $\xi(t)$ in $0 \leq t \leq T$ is considered. A formula is obtained for the factorial moment $M_k = \xi\{N(N-1)\ldots(N-k+1)\}$ of any desired order k. The main condition assumed in the derivation is that $\xi(t)$ have, with probability one, a continuous sample derivative $\xi'(t)$ in the interval [0,T]. This condition involves no real restriction since an example shows that even a slight relaxation of it causes all moments of order greater than one to become infinite. The moments of the number of down crossings or total number of crossings can be obtained analogously. Author

N65-22214# RAND Corp., Santa Monica, Calif.
AN IRREDUCIBLE GRAPH CONSISTING OF A SINGLE BLOCK
T. A. Brown and R. A. Duke Feb. 1965 18 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4340-PR; AD-611304)

A single-block graph G_n (n = 2, 3, . . .) is described, and is proven to be N-irreducible in the sense of J. W. T. Youngs. Author

N65-22215# RAND Corp., Santa Monica, Calif.
MATHEMATICAL EXPERIMENTATION IN TIME-LAG MODULATION
Richard Bellman, June Buell, and Robert Kalaba Feb. 1965 16 p refs
(Grant NIH GM-09608-03)
(RM-4432-NIH; AD-611766)

Equations of the form $du/dt = g(u(t), u(h(t)))$ arise in a number of scientific contexts. In this paper, we point out some interesting properties of the solution of $u'(t) = -u(t-1-k \sin \omega t) + \sin at$. These properties were obtained by means of numerical solution. Author

N65-22216# Northwestern Technological Inst., Evanston, Ill.
ON REPRESENTATIONS OF SEMI-INFINITE PROGRAMS WHICH HAVE NO DUALITY GAPS
A. Charnes, W. W. Cooper, and K. Kortanek (Carnegie Inst. of Tech.) Aug. 1964 17 p refs Revised
(Contracts Nonr-1228(10); Nonr-760(01))
(ONR-RM-96; AD-612186)

Duality gaps which may occur in semi-infinite programs are shown to be interpretable as a phenomenon of an improper representation of the constraint set, $u^T P_i \geq c_i$, $i \in I$. Thus, any semi-infinite system of linear inequalities has a canonically closed equivalent (with interior points) which has no duality gap. With respect to the original system of inequalities, duality gaps may be closed by adjoining additional linear inequalities to the original system. Also, for consistent, but not necessarily canonically closed programs, a partial regularization of original data removes duality gaps that may occur. In contrast, a new weakly consistent duality theorem without duality gap may have a value determined by an inequality which is strictly redundant with respect to the constraint set defined by the total inequality system. Author

N65-22225# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics
THE FIRST MEDIAN TEST: A TWO-SIDED VERSION OF THE CONTROL MEDIAN TEST
Joseph L. Gastwirth Feb. 1965 16 p refs
(Contract Nonr-4010(09))
(AD-610955)

Consider two independent samples of mutually independent observations, S_i, X_m, and Y_j, Y_n, respectively, from F(X) and G(X). Let V be the number of X's occurring before the median of the Y sample and U be the number of Y's occurring before the median of the X sample. Kimball, Burnett, and Doherty proposed a control median test based on V (where the X sample is from the control group). In the present paper a two-sided version of this test is proposed, based on U if the median of the X sample precedes the median of the Y sample, as otherwise, the test is based on V. The asymptotic distribution theory of both tests is developed under both the null and alternative hypotheses. The expected time to reach a decision is also discussed. Author

N65-22233# Stanford Univ., Calif. Dept. of Statistics
ON A CHARACTERIZATION OF THE THREE LIMITING TYPES OF THE EXTREME
J. Sethuraman 1 Feb. 1965 14 p
(Contract Nonr-225(52))
(TR-104; AD-610845)

If x and y are independent random variables then they are said to be completely confounding if the distributions of z, z conditional on z = x, z conditional on z = y are the same. If x, y, and z completely confound one another where y and z have the same distribution as ax + b and cx + d which are basically different linear functions, then the distribution of x is one of the three limiting types of the extreme (minimum) observation from independent samples from the same population. Author

N65-22259# Stanford Univ., Calif. Dept. of Statistics
THE CONVEX HULL OF A RANDOM SET OF POINTS
Bradley Efron 25 Jan. 1965 29 p
(Contracts Nonr-225(52); AF 49(638)-700)
(TR-103; AD-610844)

Various expectations connected with the convex hull of a random set of points are derived. The points are chosen independently in the plane or in higher dimensions, and formulas are given for the expected area, perimeter, volume, and number of vertices. The formulas are particularly simple for an underlying normal distribution. Author

N65-22346# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics
REGULARITY OF CERTAIN EXPLICIT SOLUTIONS TO LAPLACE'S EQUATION AT ARTIFICIAL INTERFACES[1,2]
Robert B. Kelman (Howard Univ.) Aug. 1964 12 p refs
(Contract Nonr-595(17))
(BN-368; AD-610841)

An analysis of simple and explicit solutions for calculating partial differential equations is presented. Emphasized is the ease with which proofs can be derived using simple computations, in contrast to using classical weak solutions. Proof of a theorem which establishes the regularity of an explicit axisymmetric solution of Laplace's equation is exemplified. The applicability of the proof to other similar problems, such as finding an alternative form for the solution of a boundary value problem for the two-dimensional Laplace equation, is discussed. This alternative form provides rapid convergence for values of the independent variables for which the standard series solution converges slowly. Another alternative form of a more general nature is given for this problem. S.C.W.

N65-22361*# Measurement Analysis Corp., Los Angeles, Calif.
MEAN AND MEAN SQUARE MEASUREMENTS OF NONSTATIONARY RANDOM PROCESSES

George P. Thrall and Julius S. Bendat Washington, NASA, May 1965 41 p refs
(Contract NAS5-4590)
(NASA-CR-226) CFSTI: HC $2.00/MF $0.50

Methods for analyzing nonstationary data of common occurrence in different physical situations are described. Techniques for estimating nonstationary mean values by ensemble averaging and orthogonal function approximations are discussed under the assumptions that the time t in each record $x_i(t)$ is measured from a well-defined origin and that the set of records $\{x_i(t)\}$ are statistically independent. Ensemble averaging, orthogonal approximation, and short time averaging techniques are considered for the corresponding estimation problem for nonstationary mean square values. Two applications of the orthogonal approximation technique are given, and a comparison is made between these results and ensemble averaging. A special type of nonstationary random process is considered for short time averaging. Computer based simulation of the various estimation procedures for typical nonstationary random processes of interest is recommended. G.G.

N65-22366*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON DEDUCTION OF CERTAIN NONLINEAR DIFFERENTIAL EQUATIONS FROM THEIR SOLUTIONS
Murray Tobak Washington, NASA, May 1965 10 p refs
(NASA-TN-D-2779) CFSTI: HC $1.00/MF $0.50

A method is presented for deducing certain nonlinear differential equations from their solutions. The method, relevant to equations of the type $\ddot{x} + \epsilon[\dot{x}g(x^2) + xk(x^2)] + \nu^2 x = 0$, enables the deduction of explicit forms for the nonlinear elements $g(x^2)$ and $k(x^2)$. It should apply whenever the solution can be assumed to be describable by the first approximation of the Kryloff–Bogoliuboff method. Author

N65-22376# Michigan Univ., Ann Arbor. Dept. of Communication Sciences
TOWARD A HOMOLOGICAL ALGEBRA OF AUTOMATA IV. 5: THE CHARACTERIZATION OF PROJECTIVE AUTOMATA
Yehoshafat Give'on Jan. 1965 19 p ref *Its* Rept.-06689-34-T and Rept.-03105-34-T
(Contract Nonr-1224(21); Grant DA-ARO(D)-31-124-G588)
(AROD-4049-11; AD-458296)

The problem of characterizing the projective objects of a studied category is a natural one. In the case of the category theoretic study of automata, the importance of this characterization is derived from the importance of the characterization of M_W, the input monoid regarded as an automaton. The methods of homological algebra appear to be sufficient for a complete characterization of the projective automata. This characterization implies a possible application of automata theory to the theory of monoids (in analogy to the fruitful interaction between ring theory and module theory). It also provides a characterization of M_W for finite input monoids, and thus the categorical-completeness theorem for A_W for any finite input monoid W. Author

N65-22490# Aerospace Corp., El Segundo, Calif. Manned Systems Div.
DERIVATION OF LOS RATES AND LOS RATE ERRORS FOR A SATELLITE-BORNE, TWO-GIMBALLED OPTICAL SYSTEM ABOVE A FLAT EARTH
J. E. Alexander Jan. 1965 55 p
(Contract AF 04(695)-469)
(TOR-469(5107-40)-1; AD-457910)

The ability to reduce relative motion at the eye or film plane to an acceptably low level is one of the most important factors in direct viewing or photographing the ground from a spacecraft. The derivation of the line-of-sight (LOS) rates for a two-gimballed optical system is presented. In addition, the errors in LOS rates which would occur when they were predicted on the basis of inexact values of orbital parameters and other factors affecting these rates are derived. The resulting equations have two principal applications: they provide the basis for designing a spaceborne optical system, including possible procedural methods for minimizing rates, and they can be used to establish realistic conditions for ground simulators. The derivations are based on a flat earth. This approximation results in errors of 3% or less for the altitude regime where high-resolution visual observation is possible. Since the level of uncertainty of the parameters is not known within 3%, the approximation is valid for the above stated purposes. Author

N65-22522# Sandia Corp., Albuquerque, N. Mex.
TABLE OF ARC SIN x/2 π, (d/dx) ARC SIN x, AND ARC SIN (k/n)
D. E. Amos (Missouri Univ.), D. B. Owen (Southwest Center for Advanced Studies), and G. P. Steck Dec. 1964 67 p
(SC-R-64-1386) CFSTI: $5.00

A table of (arc sin x)/2π and its derivative, $1/(2\pi\sqrt{1-x^2})$, for $x = 0.0001(0.0001)1.0000$ and for $x = k/n$, $1 \leq k \leq n \leq 100$ is presented. This computation provides the normalization by 2π. The first differences of arc sin are approximated by 0.0001 times (d/dx) arc sin x, and the second differences in arc sin x are therefore approximated by the first difference of (d/dx) arc sin x. G.G.

N65-22544*# Northeast Louisiana State Coll., Monroe. Dept. of Mathematics
MULTIVARIABLE LEAST SQUARES APPROXIMATION AND ITS APPLICATION TO SOLVING PROBLEMS ASSOCIATED WITH SPACE VEHICLES Summary Report, May 1, 1962–Feb. 1, 1965
Daniel E. Dupree 1 Feb. 1965 34 p refs
(Contract NAS8-2642)
(NASA-CR-62396) CFSTI: HC $2.00/MF $0.50

This report for the period May 1, 1962 to February 1, 1965 covers the three accomplishments which are significant in helping solve problems associated with optimized missile trajectories. These are the establishment of necessary and sufficient conditions for the existence and uniqueness of multivariable least-squares approximating functions; the development of a multivariable orthogonalization process which yields the least squares approximating function without solving the system of normal equations; and the development of a technique for obtaining an approximating function which yields an error, in the sense of least squares, that is less than a specified tolerance. Author

N65-22551*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics
HEREDITARY DEPENDENCE IN THE THEORY OF DIFFERENTIAL EQUATIONS, PART I
G. Stephen Jones (Martin Co., Baltimore) Jan. 1965 43 p refs
(Contracts NASw-845; AF 49(638)-1242; Nonr-3893(00); Nonr-595(17))
(NASA-CR-62399; BN-385) CFSTI: HC $2.00/MF $0.50

A general class of differential equations with hereditary properties is introduced; in the past, similar equations were used to describe growth properties of interacting species of organisms. The class presented allows development of a strong and tractable qualitative theory closely resembling that of

ordinary differential equations. The concept of hereditary dependence is described; theorems and proofs are given on existence, uniqueness of solutions, and dependence on initial data and parameters. J.M.D.

N65-22694# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
ITERATIVE PROCEDURES FOR NON-LINEAR INTEGRAL EQUATIONS
Donald G. Anderson Jan. 1965 30 p refs
(Grant NSF GP-414)
(TR-14)

The numerical solution of nonlinear integral equations involves the iterative solution of finite systems of nonlinear algebraic or transcendental equations. Certain conventional techniques for treating such systems are reviewed in the context of a particular class of nonlinear equations. A procedure is synthesized to offset some of the disadvantages of these techniques in this context; however, the procedure is not restricted to this particular class of systems of nonlinear equations. Author

N65-22803# Texas Technological Coll., Lubbok. School of Engineering
AN APPROXIMATION OF THE CUMULATIVE BINOMIAL PROBABILITY DISTRIBUTION
Jack M. Hamilton (M.S. Thesis) May 1965 75 p refs
(Contract AF 33(608)-1119)
(AD-612117)

The cumulative binomial distribution B(X:N,P) is the probability of X or less successes in N trials with P the probability of success in a single trial. There is no practical and concise procedure for calculating the B(X:N,P) for large values of N. There is no brief tabular presentation of the B(X:N,P) as there is for the cumulative Poisson and normal distributions. The cumulative binomial distribution is operationally defined, and the currently used approximations to it are discussed. An asymptotic expansion of the distribution of a sample sum is used to produce an approximation of the cumulative binomial probability distribution with the desired accuracy of three decimal places. TAB

N65-22804# IIT Research Inst., Chicago, Ill. Technology Center
THEOREM-PROVING BY COMPUTER Final Report, Jan. 1–Dec. 31, 1964
B. Kallick 31 Jan. 1965 70 p refs
(Contract AF 49(638)-1349)
(IITRI-H6008-5; AD-611815)

The subject is the development of efficient theorem-proving algorithms, amenable to computer implementation, through the application of the theory of mathematical logic. The approach taken is via the Herbrand theorem and consists in expressing the theorem as the negation of a prefix formula of predicate calculus and of finding an inconsistent set of instances of this formula. The following problem is dealt with: in searching for an inconsistent set of instances and having already generated certain instances of a formula, how can the information in the matrix of the formula be utilized to determine the most appropriate way of generating the next instance. In this regard, the idea of expressing the matrix in disjunctive normal form and generating instances so as to construct inconsistent subpaths is considered to be a useful technique and worthy of continued study. A partial solution to the following problem is also obtained: how can the information that a given disjunctive term of the matrix has figured in an inconsistent subpath be utilized to avoid the repetition of identical computation the next time that term is encountered. A proof procedure is described which is capable of deciding certain known solvable subcases of the decision problem. It is conjectured that the procedure yields a new solvable subcase. Author

N65-22806# St. Louis Univ., Mo.
ON A SUFFICIENT CONDITION FOR ABSOLUTE CONTINUITY
Martin David Fraser (M.S. Thesis) 1965 46 p refs
(AD-612065)

The formulation of a condition which yields absolute continuity when combined with continuity and bounded variation is the problem considered in the paper. The formal statement of this condition, called interchangeable additivity of the second kind, as a definition is the purpose of the paper. Briefly, the formulation is achieved through a discussion which develops a proof by contradiction of a sufficiency theorem for absolute continuity which uses in its hypothesis the condition of continuity and bounded variation. TAB

N65-22809# RAND Corp., Santa Monica, Calif.
ON PROVING THEOREMS IN PLANE GEOMETRY VIA DIGITAL COMPUTER
Richard Bellman Feb. 1965 6 p Submitted for Publication
(P-3068; AD-611205)

The report indicates how geometric theorems can be transformed into algebraic identities (the contribution of Descartes), and then established by the verification of a finite number of cases. The verification is arithmetic. TAB

N65-22831# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
STILL ANOTHER METHOD FOR PRODUCING NORMAL VARIABLES IN A COMPUTER
George Marsaglia Jan. 1965 9 p refs *Its* Mathematical Note No. 346
(DI-82-0345; AD-612430)

A method for producing normal random variables in terms of uniform random variables U_1, U_2, U_3, ... If $Y = U_1 + U_2 + U_3$, then choosing one of the four random variables $2Y - 3$, $(4Y - 6)/3$, $(Y - 7)/2$ or $(Y + 4)/2$ in the proportions .8365, .11506, .00372 and .00372 will produce the required normal variate 98.6% of the time. The other 1.4% is devoted to the tail or a rejection technique in order that the composite be exact. The method leads to very fast computer programs which are easy to code and occupy little space in the computer. Author

N65-22832# RAND Corp., Santa Monica, Calif.
THE PRODUCT FORM OF THE SIMPLEX METHOD
Philip Wolfe Mar. 1965 14 p refs
(P-3075; AD-612381)

This paper describes algebraically the product form of the simplex method for linear programing, and points out some of its advantages. The material is drawn from several previous publications. Author

N65-22944# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration
GENERALIZED CUTS IN DIOPHANTINE PROGRAMMING
Fred Glover Oct. 1964 34 p refs
(Contract Nonr-760(24))
(ONR-RM-132; AD-609507)

Using the tools of the bound escalation method for solving integer linear programs, a two-parameter family of constraints is derived which must be satisfied by any nonnegative integer solution to a specified equation. As a byproduct of the derivation, the Gomory inequalities may be generated from the generalized constraints by setting one of the parameters equal to infinity. Special attention is given to the class of derivative constraints called cuts, which cannot be satisfied by every non-integer solution to the original constraints. Theorems are proved which specify how to generate various types of cuts, such as those which are always at least as strong as the Gomory cuts, and those with a maximum number of coefficients of a different sign than in the Gomory cuts. Examples of cuts constructed to exhibit some of these properties are presented.
Author

N65-22951# Pittsburgh Univ., Pa.
SYNTHESIS OF FOUR BAR LINKAGE FUNCTION GENERATORS WITH PRECISION FIRST AND SECOND DERIVATIVES
Max J. Linza (M.S. Thesis) 1964 83 p refs
(Contract AF 33(608)-955)
(AD-611780)

Precision first and second derivatives in the design calculation are described. Because the equation of constraint for a four-bar linkage contains only five variables for a given set of displacement angles, inclusion of precision derivatives can be included in the calculation only by sacrificing precision points. The procedure for substituting precision first and second derivatives for the sacrificed precision points is outlined. Two examples are solved in detail: the first demonstrates the design of a four-bar function generator with three precision points and precision first derivatives at two of the points; the second illustrates the design calculation for three precision points with a precision first derivative and a precision second derivative at one of the precision points.
Author

N65-22970*# General Dynamics/Astronautics, San Diego, Calif.
A NONLINEAR ANALYSIS FOR SLOSHING FORCES AND MOMENTS ON A CYLINDRICAL TANK
H. J. Weiss and T. R. Rogge Washington, NASA, Apr. 1965 13 p ref
(Contract NAS8-11193)
(NASA-CR-221) CFSTI: HC $1.00/MF $0.50

Closed integral forms are derived for various equations that appear in the paper *An Approximate Nonlinear Analysis of the Stability of Sloshing Modes Under Translational and Rotational Excitation*, by T. R. Rogge and H. J. Weiss. A differential equation for the pressure on the liquid tank system is solved, formulas for various forces acting on the sides of the tank are integrated, and moments are derived for the forces.
J.M.D.

N65-23004*# Colorado State Univ., Fort Collins. Dept. of Mathematics and Statistics
A MODIFICATION OF THE KUHN-TUCKER THEOREM Technical Report No. 1, 1 Jun.–31 Dec. 1964
Kenzo Seo Dec. 1964 3 p ref
(Grant NsG-569)
(NASA-CR-62550) CFSTI: HC $1.00/MF $0.50

The problem of simultaneously maximizing a set of concave functions whose domain is defined by another set of concave functions is considered. It is shown that any version of the Kuhn–Tucker theorem can be modified to deal with this problem.
Author

N65-23038# Stanford Univ., Calif. Dept. of Statistics
NONPARAMETRIC LIFE TEST SAMPLING PLANS
Richard E. Barlow and Shanti S. Gupta 8 Jan. 1965 74 p refs
(Contracts Nonr-225(53); Nonr-3656(18); AF 33(657-11737)
(SUDAER-77; AD-610034)

Sampling plans for truncated life tests based on percentiles under the increasing (decreasing) failure rate assumption, as well as plans based on the mean life are discussed. Tables are given to determine the required sample sizes for a given protection.
G.G.

N65-23047# Stanford Univ., Calif. Dept. of Statistics
CALCULATION OF UPPER TAIL PERCENTILES FOR THE CHI-SQUARE DISTRIBUTION
Herman Rubin and James V. Zidek 1 Dec. 1964 15 p refs
(Contract Nonr-225(52))
(TR-102; AD-611176)

This report describes a procedure for determining upper tail percentiles of the chi-square distribution with an arbitrary number of degrees of freedom. It consists of two main parts: the first is a description of an effective iterative technique for solving equations of the form $f(x) = 0$, given the feasibility of computing f and its derivatives; the second, in the application of this technique to the chi-square distribution, is the continued fraction approximation to the tail integral of the chi-square density function. An alternative procedure is given for the cases in which the sequence of approximations to this continued fraction coverge slowly.
Author

N65-23062*# Honeywell, Inc., St. Paul, Minn. Military Products Group Research Lab.
RESEARCH AND STUDY IN SYSTEM OPTIMIZATION TECHNIQUES Progress Report, 14 Nov. 1964–14 Feb. 1965
D. L. Lukes 22 Feb. 1965 35 p refs
(Contract NAS8-5222)
(NASA-CR-62475; MPG-1546-QR-1) CFSTI: HC $2.00/MF $0.50

The correspondence between a Lyapunov function and the differential systems to which it applies was established. The autonomous case is examined in detail to arrive at canonical forms for systems with quadratic Lyapunov functions. Further, it is shown that if the Lyapunov derivative of a positive definite form V is negative in a deleted neighborhood of the origin, then a sufficient condition for global asymptotic stability is that its derivative in the direction VV be nonpositive. Also, the application of Lyapunov functions to the study of equations of disturbed motion is discussed.
E.E.B.

N65-23154# Brown Univ., Providence, R. I. Div. of Applied Mathematics
PRODUCTS OF INDEPENDENT IDENTICALLY DISTRIBUTED STOCHASTIC MATRICES
M. Rosenblatt Jan. 1964 16 p refs
(Contract Nonr-562(29))
(TR-10; AD-429907)

Previously results were obtained on the limiting distributions of products of identically distributed elements of a compact semigroup. These results were a generalization of results obtained by others in the case of a compact group. The background and general content of the results obtained on limit distributions of products of independent identically distributed elements of a compact semigroup were discussed. Also, the structure of completely simple semigroups of m X m stochastic matrices was determined.
E.E.B.

N65-23199# Boeing Co., Seattle, Wash.
TABLES OF SOME INTEGRALS INVOLVING BESSEL FUNCTIONS
A. S. Kobayashi and David L. Beste [1965] 346 p refs
(D2-23870-1)

The following integral functions involving Bessel functions are tabulated for various orders of ν and n and various coordinate locations of r and z.

$$S(\nu,n) = \int_0^\infty \xi^n \sin \xi \cdot J_\nu (r\xi) \cdot e^{-z\xi}\, d\xi$$

$$I(\nu,n) = \int_0^\infty \xi^{n-1} \cos \xi \cdot J_\nu (r\xi) \cdot e^{-z\xi}\, d\xi$$

$$Z(\nu,n) = \int_0^\infty \xi^{n-1} J_\nu (r\xi) \cdot e^{-z\xi}\, d\xi$$

Author

N65-23319# Princeton Univ., N. J.
SMALL-SAMPLE PROPERTIES OF VARIOUS SIMULTANEOUS-EQUATION ESTIMATORS: THE RESULTS OF SOME MONTE-CARLO EXPERIMENTS
J. G. Cragg Oct. 1964 418 p refs
(Contract Nonr-1858(16))
(RM-68; AD-610085)

The estimators' studied were direct least squares, two-stage least squares, Nagar's unbiased k-class estimator, limited-information maximum-likelihood, three-stage least squares, full information maximum likelihood, and least squares used to estimate the reduced form. The estimates of the structural equations, their standard errors, the estimates of the variance–covariance matrix of disturbances, the estimates of the reduced form coefficients, and the predictive ability of the methods were examined. The small sample properties of these estimators were examined in a variety of situations, concentrating especially on their performance relative to each other. A series of cases falling under the standard statistical simultaneous-equation model were studied first, and it was found that the differences between estimators were not great and depended on population parameters and structural data. The effects of violating the stochastic assumptions of the standard model were investigated next, and the results indicate that only the use of stochastic coefficients had much effect on the estimators. Misspecification of the form of the structural equations led to quite serious biases of the estimates, to larger dispersions for their estimates, to unrealiable standard errors, to changed rankings of the methods, and in some cases to completely ridiculous full-information maximum-likelihood estimates. Standard errors were found to generally lead to reliable confidence levels for the estimates except when misspecification was involved.
M.P.G.

N65-23327*# University of Southern Calif., Los Angeles Electronic Sciences Lab.
GENERALIZED BARKER SEQUENCES
Solomon W. Golomb and Robert A. Scholtz Feb. 1965 17 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951076)
(NASA-CR-62634; USCEE-123) CFSTI: HC $1.00/MF $0.50

A generalized Barker sequence is a finite sequence $\{a_r\}$ of complex numbers having absolute value 1, and possessing a correlation function $C(\tau)$ satisfying the constraint $|C(\tau)| \leq 1$, $\tau \neq 0$. Classes of transformations leaving $|C(\tau)|$ invariant are exhibited. Constructions for generalized Barker sequences of various lengths and alphabet sizes are given. Sextic Barker sequences are investigated and examples given for all lengths through 13. No theoretical limit to the length of sextic sequences was found. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-22393# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
NIKE-APACHE SPEEDBALL II (ROUND NO. 53 SN-19), 2 JULY 1964 Meteorological Data Report
H. M. Richart and S. F. Kubinski Aug. 1964 46 p
(ERDA-175; AD-454272)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round Nr. 53, SN-19, are presented for future ballistic studies. The meteorological data and resulting ballistic data appear in the appendixes. Author

N65-22460# Army Electronics Labs., Fort Monmouth, N. J. Surveillance Dept.
AREA PRECIPITATION MEASURING INDICATOR
William G. Stone Oct. 1964 54 p refs
(ECOM-2522; AD-613168)

This is a discussion of design, development, construction, and evaluation of an experimental model of the Area Precipitation Measuring Indicator (APMI). This system was designed to quantize video signals reflected from weather clouds into three measurements: intensity, range extent, and azimuthal extent; and to print these measurement data in alpha-numerical form on a direct-view storage tube. The APMI equipment operates in one of two basic modes: PPI and Off Center. In the Off Center mode, expansion of target is permitted and a blownup area is printed on the display. A general description of the overall operation and capability is followed by a detailed description of the theory of operation of the system. Results of the electrical test performed and conclusions are presented.
Author

N65-22479# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
CLIMATE CALENDAR
Paul H. Taft Feb. 1965 22 p refs Revised
(ERDA-277; AD-458316)

Mean daily maximum and minimum temperatures and extreme temperatures for the period of record (1950 to 1964) are tabulated in calendar form for the weather station located at White Sands Missile Range, New Mexico. Averages of temperature, relative humidity, precipitation, wind and cloudiness are included for each month, as well as extremes of monthly and 24-hour rainfall. A supplementary table gives monthly and annual values of maximum winds, degree days, number of days with occurrence of thunderstorms and visibility restrictions, and station pressure. Weekly means of maximum and minimum temperatures, and weekly values of precipitation are also presented, in graphs. Author

N65-22593*# National Aeronautics and Space Administration, Washington, D. C.
ON THE DIFFERENCE BETWEEN MAGNETIC STORMS WITH SUDDEN AND GRADUAL COMMENCEMENT [K VOPROSY O RAZLICHII MAGNITNYKH BUR' S VNEZAPNYM I POSTEPENNYM NACHALOM]
R. G. Afonina 9 Apr. 1962 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 1, no. 2, 1961 p 240–243
(NASA-TT-F-8210) CFSTI: HC $1.00/MF $0.50

The fundamental differences between magnetic storms with sudden and gradual commencement are enumerated. It is further shown that the SC-storms exceed in intensity the G-storms. The dependence of the number of SC-storms upon the phase in the cycle of activity is obtained, namely that during the years of increase in solar activity there are twice as many SC-storms than in the years of decrease. A correlation is noted between the number of SC-storms and the intensity D_{st} of currents within the 11-year cycle. Author

N65-22636# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.

NIKE-APACHE SPEEDBALL II, ROUND NO. 71 SN 27 (18 MARCH 1965) Meteorological Data Report

Harold M. Richart and Stan F. Kubinski Apr. 1965 40 p
(ERDA-296; AD-461157)

Meteorological data collected for the launching of Nike-Apache Speedball II, Round No. 71, SN 27, are presented for future ballistic studies. The meteorological data and resulting ballistic data appear in the appendixes. Author

N65-22637# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.

AEROBEE ND 3.159 (S/N NRI 92), (29 MARCH 1965) Meteorological Data Report

Marjorie Mc Lardie Hoidale Apr. 1965 46 p refs
(ERDA-301; AD-461168)

Meteorological data gathered for the launching of Aerobee ND 3.159 (S/N NRL 92) are presented for ballistic studies. The data, along with calculated ballistic data, appear in the appendixes. Author

N65-22673# St. Louis Univ., Mo. Graduate School

ATMOSPHERIC MICRO-OSCILLATIONS OCCURRING DURING TEMPERATURE INVERSIONS

William Andrew Beczkalo (M.S. Thesis) 1965 62 p refs
(Contract AF 33(608)-1115)
(AD-611784)

Investigation of short period air pressure micro-oscillations and their relation to synoptic weather patterns have been undertaken at Saint Louis University during the past twenty six years. The early investigators grouped the very short period oscillations (one through twenty seconds) into one class and attributed these to either turbulence associated with large values of horizontal wind speed or convective activity. Within the past year a study was made of microbarographic data recorded at Florissant, Missouri subdividing this single classification of short period micro-oscillations and analyzing the periods in the one to ten second range associated with the passage of cold fronts. TAB

N65-22739 Army Electronics Research and Development Activity, Fort Huachuca, Ariz.

NUMERICAL SOLUTION OF THE DISTRIBUTION OF WIND AND TURBULENCE IN THE PLANETARY BOUNDARY LAYER

J. F. Appleby and W. D. Ohmstede *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 85-99 refs (See N65-22732 12-34)

A planetary boundary layer model is presented which unifies micro- and macroscale measurements in meteorology. The two scales were used to measure different atmospheric phenomena: The logarithmic wind profile equation relates the vertical distribution of wind speed immediately above the earth surface to the momentum transport and roughness characteristics of the surface, while the geostrophic wind equation is used to evaluate the horizontal field of wind in the free atmosphere from knowledge of the pressure distribution. Characteristic of the planetary model is that in the free atmosphere the wind approaches the geostrophic wind, while in the surface boundary layer the wind profile is logarithmic. Study of the model was limited to the barotropic, adiabatic, steady-state case, and requires extension to a broader class of situations. J.M.D.

N65-22768# Emmanuel Coll., Boston, Mass. Research Language Center

THE THEORY OF THE PROGRESS OF CRYSTALLIZATION IN SUPERCOOLED CLOUDS [K TEORII RASPROSTRANENIIA KRISTALLIZATSII V PEREOKHLAZHDENNYKH OBLAKAKH]

V. I. Beliaev Apr. 1964 15 p refs Transl into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 4, 1963 p 841-845
(Contract AF 19(628)-3869)
(E-T-R-64-25; AD-611119)

The solution of the complete problem of the progress of crystallization in supercooled clouds which takes crystal precipitation into consideration is very awkward. This work presents an approximate theory of the progress of crystallization in supercooled clouds. The theory takes into account the gradual precipitation of ice crystals from a cloud and can be applied to the entire period of the crystallization progress in the clouds. TAB

N65-22771# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

DIURNAL TEMPERATURE CHANGE IN THE ATMOSPHERE BETWEEN 30 AND 60 KM OVER WHITE SANDS MISSILE RANGE

Norman J. Beyers and Bruce T. Miers Apr. 1965 19 p refs
(ERDA-284; AD-461153)

Diurnal temperature variations between 30 and 60 km were determined in a series of 11 meteorological rocket soundings from 0400 MST February 7, 1964 through 0205 MST February 8, 1964 over White Sands Missile Range, New Mexico. The soundings were spaced at 2-hour intervals and temperatures were measured with thermistor-type instrumentation suspended on a parachute. Minimum temperatures occurred about 1400 MST. The temperature range decreased from near 20° C at 55 km to 15° C at 45 km and to near 5° C at 35 km. Significant nondiurnal heating was also present. An additional set of temperature soundings made at 1400 and 1600 MST on November 21, 1964 and 0400 and 0600 MST on the 22nd over White Sands Missile Range was available for comparison. These soundings indicated a day-to-night variation of 15° C from 63 km down to 55 km with marked dampening of variation thereafter. The November soundings may not represent the entire diurnal range since the soundings might have included large-scale nondiurnal heating which was impossible to isolate. Author

N65-22777# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

ATHENA FLIGHT NUMBER 010 VEHICLE D-003 Meteorological Data Report

Harold M. Richart Feb. 1965 64 p refs
(ERDA-273; AD-460845)

Meteorological data gathered for the launching of Athena Flight Number 010, Vehicle #D-003, are presented for ballistic studies. The data are presented in tabular form. Author

N65-22778# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET MICROMETEOROLOGY, COMPILATION OF ABSTRACTS Surveys of Soviet-Bloc Scientific and Technical Literature
14 Apr. 1965 69 p *Its* Rept.-3
(ATD-P-65-18; AD-461108) CFSTI: HC $3.00/MF $0.75

An annotated bibliography of reports on various aspects of Soviet micrometeorology, based on selected representative Soviet open source literature published in 1962 is given. The data are grouped under the subject headings of general, aerosols, stagnant weather conditions, air pollution, and boundary layer turbulence. L.S.

N65-23086# Texas A&M Research Foundation, College Station.
MESOSCALE CIRCULATION OF THE ATMOSPHERIC BOUNDARY LAYER Final Report
Kenneth C. Brundidge Jan. 1965 131 p refs
(Contract AF 19(604)-7455)
(AFCRL-65-63(I); AD-611312)

Results are given of research conducted in three major areas: the temperature and wind structure of cold fronts, determination of the eddy heat coefficient under fair-weather conditions, and the determination of the eddy heat coefficient in frontal zones. The investigations were based upon data collected on the 1420-ft KRLD-WFAA transmitter tower at Cedar Hill, Texas. Author

N65-23096# Travelers Research Center, Inc., Hartford, Conn.
DIAGNOSIS OF SURFACE WEATHER CONDITIONS FROM OBSERVED AND PROGNOSTIC UPPER-AIR PARAMETERS Technical Report, Oct. 1963–Dec. 1964
Russell G. Harris, Joseph G. Bryan, and James E. Mac Monegle Bedord, Mass., AFSC, Feb. 1965 145 p refs Prepared for United Aircraft Corp.
(Contract AF 19(628)-3437)
(Rept.-7463-156; ESD-TR-65-2; AD-611584)

Objective techniques being developed for interpreting grid-point analyses and prognoses produced by computerized dynamical models in terms of concomitant surface-weather conditions are described. Multiple regression equations were derived to express statistical relationships between surface-weather variables and derived upper air parameters representing pertinent physical processes taking place between the surface and the 500-mb level. These upper-air parameters were derived from observed height and thickness values and the climatological statistics of these values. Work being conducted is discussed. Improvement is being sought by the definition of better predictor parameters to represent orographic effects and by the incorporation of moisture information available from dynamical models. Author

N65-23323# Sandia Corp., Albuquerque, N. Mex.
THE USE OF METEOROLOGICAL DATA BY SANDIA CORPORATION
H. J. Plagge Feb. 1965 13 p refs Presented at the 2d Natl. Conf. on Appl. Meteorol: Eng., Ann Arbor, Mich., 9–11 Sep. 1958
(SCR-47)

The range-type meteorological instrumentation used at Salton Sea Test Base and at Tonopah Test Range is described. The standard data that must be furnished for a test include pressure, temperature, density, and speed of sound and winds, all vs. altitude. The methods used to compute these data and some applications are discussed. A comparison of the desired and the actually obtained accuracies shows a need for improvement in all areas. The futility of applying low-level data obtained from an onshore location to overwater operations is demonstrated in a discussion and map of thermal variability in the Salton Sea and Imperial Valley region. A two-stage program to improve the meteorological data for tests is underway; the first stage involves relocation of sounding release points as close as safety will permit to the targets used and improvement of instrumentation, and the second stage involves substantially improved instrumentation with greater accuracy and altitude capabilities. M.P.G.

N65-23337# Joint Publications Research Service, Washington, D. C.
MEASUREMENT OF LOW ATMOSPHERIC PRESSURES WITH CONVECTION AND IONIZATION MANOMETERS
M. T. Dmitriyev 3 May 1965 22 p refs Transl. into ENGLISH from Tr. Nauchn. Issled. Inst. Gidrometeorol. Priborostr. (Moscow), no. 11, 1963 p 49–61
(JPRS-29856; TT-65-30874)

This article discusses the possibilities of the use of certain types of manometric sensors for measurement of atmospheric pressure in the range 10^{-7} to 1100 mb. A study has been made of the conditions for convective and molecular heat transfer and the efficiency of ionization processes for measurements of pressure. Also given are some results of investigation of convection, thermoelectric, ionization and radioactive manometers. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-22865# Arcon Corp., Lexington, Mass.
ANALYSIS OF ORGANIZED ROUTE SYSTEMS IN THE NORTH ATLANTIC Final Report
Sep. 1964 253 p refs
(Contract FA-WA-4620)
(RD-64-142; AD-611084)

This report presents the results of a detailed examination of operational and economic consequences of adopting organized route procedures in the North Atlantic Air Traffic Control System. Particular emphasis is placed on the aircraft users' requirements and their use as basic criteria in the determination of the economic implications of organized route systems. Also presented is a technique for the formulation of traffic forecasts and a discussion of their significance to the system designer. Several proposed changes and improvements in the present organized route system are analyzed in terms of their operational and economic significance. Detailed mathematical treatments and descriptions of digital computer simulations used in the evaluation of system performance are given in the appendices. These are: A. analysis of organized route geometry, B. air traffic control model, and C. flight time penalty evaluation. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-22358*# United Aircraft Corp., East Hartford, Conn.
THEORETICAL VISCOSITIES AND DIFFUSIVITIES IN HIGH-TEMPERATURE MIXTURES OF HYDROGEN AND URANIUM
S. B. Schneiderman Washington, NASA, Apr. 1965 135 p refs
(Contract NASw-847)
(NASA-CR-213) CFSTI: HC $4.00/MF $1.00

Coefficients of viscosity and diffusion were calculated for multicomponent mixtures of hydrogen and uranium in order to provide data for use in studies of gaseous nuclear reactor concepts. These properties were calculated for 18 fuel partial pressure ratios, P_{FUEL}/P, ranging from 0.0 (pure hydrogen) to 1.0 (pure fuel), for nine temperatures from 20000° to 100000° K, and for pressures of 100, 500, and 1000 atmospheres. Some of the calculations for pure hydrogen were also performed for a temperature of 10000° K. The calculated values of viscosity and diffusion coefficients for the multicomponent hydrogen–uranium mixtures were used to calculate the Schmidt number—a dimensionless group which relates the scales of momentum and mass transfer—for each mixture. For values of P_{FUEL}/P greater than approximately 0.03, the Schmidt number was found to be less than unity, thus indicating that, for gradients of the same magnitude in velocity and concentration, mass flux due to diffusion will proceed at a greater rate than momentum flux due to viscosity. For values of P_{FUEL}/P less than approximately 0.03, the Schmidt number exceeded unity, thus indicating a reversal in the relative magnitudes of momentum and diffusive flux. Author

N65-22504# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
THE APPLICATION OF THE FAST CHOPPER AS A PULSE NEUTRON SOURCE FOR NEUTRON DIFFUSION PARAMETER MEASUREMENTS
Zb. Ogrzewalski and T. Rzeszot Nov. 1964 10 p refs
(Rept.-539/IX)

The fast chopper, operating at the horizontal channel of the EWA reactor, is applied as a pulse neutron source for measuring the neutron diffusion parameters of moderators. The burst of neutrons is injected into a moderator and the decay constant α of the asymptotic thermal neutron flux is measured. Some preliminary results for organic glass obtained by this method are presented. Author

N65-22520# Kansas State Univ., Manhattan. Dept. of Nuclear Engineering
A GRAPHITE SUBCRITICAL REACTOR LABORATORY FOR NUCLEAR ENGINEERING
Oak Ridge, Tenn., AEC Div. of Tech. Inform., Mar. 1965 280 p refs
(Contract AT(11-1)-1125)
(TID-19943) CFSTI: $6.00

A guide designed for use in the fabrication of a basic nuclear engineering laboratory centered about a graphite subcritical assembly or pile is presented. Topics discussed include licensing, Atomic Energy Commission assistance grants, site criteria, graphite specifications, assembly, neutron detection, radiation safety, pile design considerations, and a list of recommended equipment. Experiments on counting statistics, isotope buildup, cadmium ratio, Fermi age, diffusion length, measurements of effective pile size, critical size and effective multiplication factor, and electronic circuitry for nuclear detection, are presented. S.C.W.

N65-22675# European Space Vehicle Launcher Development Organization, Paris (France).
SPACE APPLICATIONS OF NUCLEAR ENERGY [APPLICATIONS SPATIALES DE L'ENERGIE NUCLEAIRE]
J. P. Contzen. Oct. 1964 53 p refs In FRENCH
(ELDO-TM/F/6)

The overall possibilities for the application of nuclear energy in space is reviewed. Propulsive applications treated in the first part include thermonuclear, nuclear electric, and ionic propulsion; these are treated in general terms. The part concerned with nonpropulsive applications of nuclear energy is essentially devoted to the problem of producing auxiliary electric energy onboard space vehicles, and the discussion is principally on sources of energy and conversion systems. This document is equally intended to define the orientation which should be given to European research in this domain.
Transl. by M.P.G.

N65-22688# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation
HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 46, Part A, 1 Feb.–1 Mar. 1965
15 Apr. 1965 34 p refs
(Contract AT(40-1)-2847)
(GEMP-46A) CFSTI: $2.00

Progress is reported in four specific areas: (1) fuel product transport processes in refractory-metal fuel systems; (2) internal conversion ceramic fuel elements; (3) radiation effects in BeO; and (4) fission gas diffusion in unfueled ceramic materials. Among the work discussed was the extrapolation of the fuel retention data at 1200° C in air from 5000 to 15000 hours which indicated that BeO-base fuel elements containing 7 to 25 volume percent UO_2–ThO_2 and UO_2ThO_2–Y_2O_3 would lose less than 1% UO_2. Based on fuel loss and nonnuclear thermal stability, the potential operating lifetime of these fuel elements appears only slightly less at 1400° C than at 1200° C. Further, BeO-coated BeO-base fuel elements containing UO_2–ThO_2–Y_2O_3 compositions demonstrated better thermal stability than any known homogeneously fueled BeO elements. Two irradiation tests of fuel elements containing 25 volume % UO_2–ThO_2–Y_2O_3 have operated for 2000 hours at 1250° C satisfactorily. E.E.B.

N65-22748 Army Engineering Research and Development Labs., Fort Belvoir, Va.
CLOSED CYCLE GAS TURBINE
W. M. Crim, Jr. *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 221–235 refs (See N65-22732 12-34)

The theories and concepts used in the design, fabrication, construction, and initial testing of the experimental compact closed cycle (AK process) thermodynamic system are reviewed. To test these ideas, the Closed Cycle Gas Turbine Test facility (GTTF) was designed for conducting an experimental test and evaluation program. System characteristics, power balance analysis, and a schematic of the GTTF are given, along with illustrations of the compact closed cycle system, and turbine and compressor performance. Results from initial experimentation with the closed cycle system indicate the importance of four general areas: (1) Sizing of the equipment is extremely critical; components must withstand extreme temperature changes. (2) Detailed design analysis is necessary for matching the equipment. (3) The performance of each component is interrelated. (4) Analytical methods have proved informative when appropriate parameters are measured accurately. It was concluded that although considerable experimental testing should be performed, a compact closed gas cycle employing basic aerothermodynamic principles can provide an efficient compact reactor system. M.G.J.

N65-22770# AiResearch Mfg. Co., Phoenix, Ariz.
[SNAP 50/SPUR NUCLEAR MECHANICAL POWER UNIT] Quarterly Technical Progress Report, Jan. 1–Mar. 31, 1965
R. D. Gruntz 17 Apr. 1965 223 p ref
(Contracts AF 33(615)-2289; AF 33(615)-1551)
(APS-5152-R2; AD-461733)

This report describes work on the SNAP 50/SPUR Nuclear Mechanical Power Unit program from January 1, 1965, to March 31, 1965. Continued development of the conversion-system components for the SNAP 50/SPUR power unit was provided for. Progress is reported for seven major task areas. The program progress on each of the tasks is presented. Author

N65-22818# Naval Radiological Defense Lab., San Francisco, Calif.
EXPERIMENTAL DETERMINATION OF THE GAMMA-RAY ANGULAR DOSE ALBEDOS OF CONCRETE, ALUMINUM AND STEEL
T. H. Jones, N. E. Scofield, L. G. Haggmark, and W. J. Gurney 6 Oct. 1964 55 p refs
(USNRDL-TR-790; AD-542958)

The angular distribution of dose albedo was measured for semi-infinite concrete, aluminum and steel slabs irradiated by plane-parallel beams of Cobalt-60 and Cs^{137} gamma photons. The photons were incident on the slabs at angles, measured from a normal to the slab, of arccos 1.00, 0.75, and 0.50. For the necessary sensitivity, the reflected dose rate was measured by a digital dosimetry system using a plastic scintillator as the detector. Author

N65-22849*# Technical Research Group, Inc., Syosset, N. Y.
EFFECT OF SHIELD SPLITTING AND PLACEMENT IN NUCLEAR PROPELLED SPACE VEHICLES Final Report
Raphael Aronson, Carl N. Klahr, Herbert Steinberg and Kalman Held 1 Mar. 1961 138 p refs
(Contract NASw-132)
(NASA-CR-62456; TRG-136-FR) CFSTI: HC $4.00/MF $1.00

The effect of splitting and placement of various idealized shadow shield configurations appropriate to manned nuclear rockets was investigated. The effect on neutron dose in both hydrogenous and nonhydrogenous shield situations was considered, as well as the effect on gamma dose. The results indicate that in some circumstances proper placement or multiple splitting of the shield can affect the dose by a factor of three or more, over and above any r^2 effect due to differences in the relative sizes of reactor and payload. Author

N65-22962# Atomic Energy of Canada Ltd., Chalk River, Ontario.
ZED-2 EXPERIMENTS WITH AN ENRICHED UO_2 FUEL BUNDLE IN AN NPD LATTICE
R. E. Green Dec. 1964 32 p refs
(AECL-2157) Available from Atomic Energy of Canada Ltd., Chalk River: $1.00

Experiments were done in ZED-2 to determine the flux perturbations and reactivity effect produced in an NPD mockup lattice by a CANDU-type fuel bundle containing enriched UO_2 (2.50 wt% U-235). The maximum thermal flux perturbations observed in the ZED-2 lattice were +18% at the surface of a neighboring fuel channel and +19% in an adjacent fuel bundle in the same fuel channel. A simple method, based on the ZED-2 measurements, is outlined for predicting the reactivity effect of a similar enriched UO_2 bundle in the NPD reactor. The method gives good agreement with the effects observed to date in NPD. Author

N65-22975*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. New Product Research Dept.
INVESTIGATION, TESTING, AND DEVELOPMENT OF AN ELECTRON-BOMBARDMENT ION ENGINE SYSTEM Final Report, Mar. 3–Dec. 14, 1964
A. C. Eckert, R. J. Coerdt, M. B. Moffett, and M. W. Mueller 15 Dec. 1964 132 p refs
(Contract NAS3-5745)
(NASA-CR-54148; TRW-ER-6291) CFSTI: HC $4.00/MF $1.00

An applied research program of investigation, testing and development of an electron-bombardment, mercury-fueled ion engine system is reported. Ion source performance data are presented for a wide range of conditions of operation, employing electromagnets and a laboratory feed system. Supplementary efforts to develop long-life, efficient, porous-nickel-matrix cathodes are described. Extended tests of over 500 hours on ion engine systems utilizing permanent magnets are reported, and system lifetime estimates based thereon are presented. The associated facility for automatic engine testing is described in detail. Author

N65-22976# Battelle Memorial Inst., Columbus, Ohio.
PREPARATION AND IRRADIATION OF BERYLLIA-COATED FUEL PARTICLES
Wilbur J. Wilson, Melvin F. Browning, Virginia M. Secrest, and John M. Blocher, Jr. 16 Mar. 1965 73 p refs
(Contract W-7405-ENG-92)
(BMI-1718) CFSTI: $2.00

High-purity beryllia coatings were applied to UO_2 particles in a heated fluidized bed by several chemical reactions. Hydrolysis of $BeCl_2$ was the most promising and most thoroughly investigated. Dense beryllia-coated particles survived out-of-pile evaluation but failed severely during irradiation at 100° C. Performance during irradiation at elevated temperatures was good, but cracking occurred on thermal cycling. Coating grain structure and porosity varied with preparation temperature. Dense coatings with large equiaxed grains were obtained at 1400° to 1500° C, while porous coatings with submicron grains were obtained at 600° to 1100° C. Radially oriented needle-shaped grains were produced at 1250° C. The c-axis of BeO grains in dense coatings tended to be oriented radially. Coating density and hardness were essentially equal to that of single-crystal BeO. Addition of Al_2O_3, MgO, SiO_2, or ZrO_2 failed inhibit formation of large BeO grains during subsequent heat treatment. Carbon was found to have an inhibiting effect. Author

N65-22979# Atomics International, Canoga Park, Calif.
SRE MARK II FUEL HANDLING MACHINE
H. B. Dietz 20 Apr. 1965 69 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10817) CFSTI: $3.00

The Sodium Reactor Experiment Mark II Fuel Handling Machine was modified to ensure fuel and gas containment during Core III operation. A new control system was designed for the fuel handling machine. The design, operation, and hazard aspects of the fuel handling machine are discussed. It is concluded that the Fuel Handling Machine will safely and reliably handle SRE Core III fuel. Author

N65-22987# Phillips Petroleum Co., Idaho Falls, Idaho.
MEASUREMENT OF FISSION PRODUCT LEAKAGE FROM FUEL ELEMENTS STORED IN WATER
D. W. Rhodes Mar. 1965 11 p
(Contract AT(10-1)-205)
(IDO-14654) CFSTI: $1.00

A method for detecting cladding defects in fuel elements stored underwater by measuring the rate of increase in the concentration of radioisotopes in the water is described. The only special equipment needed is a stainless steel container with compressed air and water connections, and conventional beta counting equipment. The method can be used for any type of solid fuel that is suitable for underwater storage.
Author

N65-22990# Argonne National Lab., Ill. Reactor Engineering Div.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF A NUCLEAR REACTOR SUPPORT STRUCTURE
A. H. Marchertas, S. H. Fistedis, and R. O. Brittan Mar. 1965 100 p refs
(Contract W-31-109-ENG-38)
(ANL-6781) CFSTI: $4.00

A general procedure is presented for determining the deformation (slopes and deflections) of a grid support structure for a nuclear reactor. Use is made of the Rayleigh–Ritz perturbation method which involves an infinite series of polynomials. The grid structure consists of two circular perforated plates separated and interconnected by a large number of tubes. The holes are distributed in a hexagonal pattern with respect to the center of the plates. Tubes pass through each hole and serve as supports for loads acting on the top end of every tube. The edges of the plates are peripherally supported and may have any degree of restraint ranging from fixed to simple supports. The complexity introduced by the holes in the plates is circumvented by the use of an equivalent solid plate. This idea is also applied to approximate pertinent stresses in the perforated plates. A model was constructed to yield some experimental data. The analytical predictions, provided by an IBM 704 Fortran II computer program, were compared with the experimental results. The results were discussed, and appropriate conclusions were drawn. Author

N65-23009# Lockheed-Georgia Co., Marietta. Georgia Nuclear Labs.
COMPONENTS AND SUB-ASSEMBLIES, SNAP 8 RADIATION EFFECTS TEST PROGRAM, VOLUME III
Jan. 1965 319 p Prepared for Aerojet-Gen. Corp.
(ER-7644)

Diodes, silicon control rectifiers, resistors, capacitors, and subassemblies underwent radiation tests at 160° and 100° F in the helium atmosphere of a controlled heat sink chamber. The 160° F test at 2×10^{11} showed some changes in the subassembly operation and slight increases in reverse leakage and forward drop of the diodes. The 100° F test with higher nuclear exposure increased the forward voltage drop and the reverse leakage current of the diodes. Changes in the operational characteristics of all subassemblies were induced through the considerable scatter from the radiated semiconductors. The circuits became unbalanced and shifted the outputs accordingly, especially in the voltage sensing units. The silicon control rectifiers suffered increased forward blocking currents, reverse leakage current, increased firing voltages, and even nonfiring. The resistors and capacitors showed no radiation effects. Postirradiation inspection revealed discoloration of some terminal strips and of the anodized coating on a few heat sinks. Data from both tests indicate no changes due to temperature. G.G.

N65-23010# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
ADVANCED TEST REACTOR: TURBO REPORT
Robert A. Turner Washington, AEC, Jan. 1964 46 p refs Prepared for Ebasco Services, Inc.
(Contract AT(10-1)-1075)
(IDO-24459) CFSTI: $3.00

The time-dependent behavior of the Advanced Test Reactor was calculated on the Philco 2000 computer, using the turbo depletion program. The fuel-and-boron loading used gave the desired 17 full power days of operation while using a maximum amount of movable control. The controls were adjusted throughout the lifetime so that the deviation was less than ±4% from the desired 60–50–40 MW power split. In addition, the experiment performance requirements were achieved in all but the A-3 experiment. The maximum ratio of the peak-to-average core power, 2.52, occurred in Element F-39. The power-peaking factors were calculated at various time steps by imposing a Maxwellian spectrum on the burnout shape generated by the Wigner–Wilkins spectrum; these factors were not corrected, however, for the axial peaking effect. Author

N65-23011# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.
ADVANCED TEST REACTOR SERVO REGULATOR ROD TEST PROGRAM
R. T. Pickett, III Washington, AEC, Feb. 1964 58 p Prepared for Ebasco Services, Inc.
(Contract AT(10-1)-1075)
(IDO-24462) CFSTI: $3.00

This program was performed: to verify rod mechanism characteristics; to demonstrate that rod mechanism characteristics were compatible with reactor kinetics and that overall reactor system behavior was stable; and to recommend system modifications needed for satisfactory performance. The overall system response was good. Except for the addition of a position feedback potentiometer, the rod drive system required no mechanical modification. Since specific lead–lag network components and controller gains can now be given for initial setup at the site, field adjustment for desired plant performance can begin. Author

N65-23012# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, March 1965
R. M. Adams and A. Glassner 20 Apr. 1965 95 p refs
(Contract W-31-109-ENG-38)
(ANL-7028) CFSTI: $3.00

Progress was reported on the liquid-metal cooled reactors, general reactor technology, advanced systems research and development, and nuclear safety. Also, a list of publications and reports is included. Among the activities reported were the repair of the leaky evaporator for EBR-II, and the operation of the reactor at 45 MW, the maximum power level planned at this stage. All systems were performing in a stable, satisfactory manner. The turbine generator was in operation and about 14-MW gross was being delivered. E.E.B.

N65-23015# Società Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari
PROBLEMS OF FISSION PRODUCT DIFFUSION IN GRAPHITE FUEL ELEMENTS
G. Cesoni, B. Chinaglia, and H. Walther 1963 25 p refs Presented at the 8th Nucl. Congr., Rome, 17–23 Jun. 1963
(SORIN-15)

Studies on diffusion problems of fission products in graphite are reported, and preliminary results concerning numerical calculations of some peculiar diffusion problems; measurements of diffusion coefficients in pyrographite, and of the fission

fragment ranges in pyrographite caused by the recoil effect; and nondestructive determination of the uranium masses in coated particles, are presented. General conclusions drawn from these preliminary studies are these: (1) Numerical methods for diffusion calculations have been proven which are reliable in diffusion problems where analytical solutions do not exist. (2) A method to measure the distribution of fission products in a plane thin pyrographite sample has been developed and checked. (3) Diffusion coefficients in pyrographite have been measured. A fast migration rate for Ba^{140} was observed, confirming that pyrographite is not a very effective diffusion barrier for Ba. (4) Nondestructive methods to determine uranium traces have been developed using activation analysis techniques. These methods have been applied to measure the mass distribution of coated particles. S.C.W.

N65-23028# Oak Ridge National Lab., Tenn. Isotopes Development Center

PREPARATION OF A CESIUM (^{137}Cs) BOROSILICATE GLASS POWER SOURCE

C. L. Ottinger, E. E. Pierce, and R. W. Schaich Apr. 1965 19 p refs

(Contract W-7405-ENG-26)

(ORNL-3669) CFSTI: $2.00

A cesium (^{137}Cs) borosilicate glass power source with 125-W thermal output was prepared. Techniques for the preparation of the fuel material, its casting into the proper form, and the fabrication of the final source capsules were developed. The chemical processing, fuel preparation, source encapsulation, heat output measurements, capsule leak-rate determinations, and measurements on the loaded shipping cask are described. Author

N65-23050# Hanford Atomic Products Operation, Richland, Wash.

RESEARCH AND DEVELOPMENT ACTIVITIES: FIXATION OF RADIOACTIVE RESIDUES Quarterly Progress Report, Oct.–Dec. 1964

A. M. Platt, ed. Jan. 1965 51 p ref

(Contract AT(45-1)-1350)

(HW-84603) CFSTI: $3.00

Leaching tests on Redox borosilicate glass and a Purex phosphate solid showed an initial penetration rate of 10^{-2} cm/day and decreased by a factor of ten in less than 2 weeks. Search continued for compositions in the Purex 1WW–P_2O_5, 1WW–P_2O_5–PbO, 1WW–B_2O_3, 1WW–B_2O_5, and 1WW–CaO–B_2O_3–P_2O_5 systems which will produce homogeneous melts at low temperatures. High chromium–nickel alloys showed good corrosion resistance to Purex waste–calcium borate melts at 900°C. The coupled spray calciner and melter was operated with simulated 1WW waste with either orthophosphoric acid, colemanite, or borax added as fluxes. More than 95% of the ruthenium in an alkaline condensate was removed and a 30-fold volume reduction achieved by electrodeionization. The relationship between zeolite silica to alumina ratio and cesium and strontium selectivity was found for 10 sodium-based zeolites. Vapor pressure versus temperature data were obtained for three waste compositions, and an approximate model for maximum steady-state cake temperatures was developed. G.G.

N65-23051# Hanford Atomic Products Operation, Richland, Wash.

RESEARCH AND DEVELOPMENT PROGRAMS EXECUTED FOR THE DIVISION OF REACTOR DEVELOPMENT Quarterly Progress Report, Jul.–Sep. 1964

J. K. Green, ed. Dec. 1965 92 p refs

(Contract AT(45-1)-1350)

(HW-84384) CFSTI: $4.00

Progress was reported in the following areas: analytical studies and advanced concepts, chemical research and development, fuels, gas-cooled reactor, instrumentation and nondestructive testing, irradiation effects on materials and materials development, physics, and plutonium recycle test reactor operation and related functions. Among the specific items reported were the estimates of the time required for fuel slumping to occur in oxide fuels whose density is less than theoretical. It was found that fuel displacement was slowest for smallest diameters. A total displacement of 5 cm was calculated to require 100 msec for 1/8-inch diameter and 40 msec for 1/2-inch diameter fuel rods. Thus, small fuel rods, in addition to having a smaller thermal time constant, should be more stable against slumping. Also, results of the BeO–PuO_2 impaction studies indicated that the BeO matrix will bond when impacted at 1200°C and that small amounts of PuO_2 can be safely handled in the presence of BeO. E.E.B.

N65-23127# Oak Ridge National Lab., Tenn. Isotopes Development Center

RADIOISOTOPE PRODUCTION IN POWER REACTORS

A. F. Rupp, J. A. Cox, and F. T. Binford May 1965 60 p refs

(Contract W-7405-ENG-26)

(ORNL-3792) CFSTI: $3.00

The possibility of producing large amounts of radioisotopes in 18 power reactors, together with some of the problems of establishing such a program, was investigated. Because of limitations of flux, irradiation time, and possible uses, seven radioisotopes—^{14}C, ^{60}Co, ^{170}Tm, ^{210}Po, ^{238}Pu, ^{242}Cm, and ^{244}Cm—were chosen for study. The amounts and specific activities which might be produced in all 18 reactors were calculated, and the approximate costs were estimated for one particular reactor. Author

N65-23148# Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.

ADVANCED TEST REACTOR BURNOUT HEAT TRANSFER TESTS

M. W. Croft Jan. 1964 58 p Prepared for Ebasco Services, Inc.

(Contract AT(10-1)-1075)

(IDO-24465) CFSTI: $3.00

Burnout tests were conducted to determine limiting heat flux in a simulated (Advanced Test Reactor) ATR fuel element channel. Burnout was approached holding all variables constant except one. Power, pressure, flow, and inlet temperature were varied to approach burnout in different tests. Channel exit pressures were varied from 80 to 250 psia, mass velocities from 5.5×10^6 to 12.5×10^6 lb/hr-ft^2, and inlet temperatures from 120° to 240°F. Maximum heat flux at burnout varied from 0.95×10^6 to 3.88×10^6 Btu/hr-ft^2. Burnout in the 0.054- and 0.072-inch channels was due to hydraulic instability or autocatalytic vapor binding when the coolant reached saturation at the exit of the channel. Burnout in the 0.094-inch channel occurred at a power level less than that required to produce saturation at the exit in most of the tests. The burnout heat flux in this channel was about 60% of the burnout flux predicted by Bernath's equation. Author

N65-23172*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio.

OPERATION OF A HAYNES ALLOY NO. 25 FORCED CIRCULATION LOOP TO STUDY THE EFFECTS OF HYDROGEN IN A SIMULATED SUNFLOWER SYSTEM

R. C. Schulze and D. B. Cooper Washington, NASA, May 1965 124 p refs

(Contract NAS5-462)

(NASA-CR-225; ER-6005) CFSTI: HC $4.00/MF $1.00

A study of inherent problems associated with the use of lithium hydride in an energy storage device in the Sunflower power system is presented to evaluate the effects of hydrogen in the mercury working fluid on operational reliability. Of particular interest are problems associated with the centrifugal-type transfer pump. A forced circulation mercury loop was designed, constructed, and operated to (1) evaluate the hydrogen swallowing capability of the Sunflower mercury transfer pump; (2) evaluate the effectiveness of various separators in removing hydrogen from the system; (3) evaluate the effectiveness of a getter-type corrosion product separator in removing corrosion products from the system; and (4) determine the corrosion and mass transfer which occurred during operation of the loop. Attempts to remove hydrogen from the system through Haynes alloy No. 25, Croloy 9M, and columbium diffusion windows were unsuccessful; also, attempts were unsuccessful using a centrifugal separator employing a columbium or a 1010 steel diffusion window. No distinct correlations could be determined concerning the ability of the centrifugal mercury pump to accept either single bubbles of hydrogen or hydrogen entering the pump inlet at a constant rate. Data on the extent of corrosive damage to the boiler, superheater region, condenser and subcooler sections of the loop are presented. S.C.W.

N65-23228# Argonne National Lab., Ill.
STUDIES OF FAST REACTOR FUEL ELEMENT BEHAVIOR UNDER TRANSIENT HEATING TO FAILURE. II: IN-PILE EXPERIMENTS ON UO_2 SAMPLES IN THE ABSENCE OF COOLANT
C. E. Dickerman, L. E. Robinson, E. S. Sowa, and S. B. Skladzien Jan. 1965 49 p refs
(Contract W-31-109-ENG-38)
(ANL-6845) CFSTI: $3.00

Uranium oxide fuel samples were exposed to transient power bursts of the order of 0.5-sec duration, in the absence of coolant, with heating rates up to the order of 4000° C/sec. Radial temperature profiles in the fuel during the power bursts were estimated to be comparatively uniform within about 15%. Cladding temperature lagged behind the fuel temperature, thermal equilibrium between fuel and cladding being reached about 2 sec after the peak of the power pulse. Sample cooling was predominantly by thermal radiation. Failure was comparatively nonviolent for the specimens tested. For the stainless steel clad elements, failure occurred near the cladding melting point. Three high-temperature niobium-clad samples attained cladding temperatures about 200° to 300° C above the cladding. The high-temperature failures of tantalum-clad elements, with the subsequent emission of molten fuel, appeared to be in reasonable agreement with the failure prediction of the simple bursting model. Onset of the appearance of the recrystallized central oxide granular structure occurred for maximum central-fuel temperatures above the order of 2200° C. E.E.B.

N65-23233# Battelle-Northwest, Richland, Wash. Reactor and Materials Technology Lab.
STRESS RUPTURE TESTS OF ZIRCALOY-2 PRESSURE TUBES
R. C. Aungst Jan. 1965 28 p refs
(Contract AT(45-1)-1830)
(BNWL-8) CFSTI: $2.00

Zircaloy-2 pressure tubes were subjected to creep and stress rupture tests under conditions of biaxial stress at temperatures of 300° C and higher. Comparison with uniaxial tests on strip shows that tubing requires 60% higher stresses for comparable creep rates. Stress rupture tests indicate 20-yr life for the tubing at stresses more than four times the design stress for the reactor. Initial tests on irradiated tubing show about 5% improvement in creep strength resulting from 3-yr exposure in a production reactor. Author

N65-23234# Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
FRETTING CORROSION IN THE PLUTONIUM RECYCLE TEST REACTOR
W. K. Winegardner Mar. 1964 35 p refs
(Contract AT(45-1)-1350)
(HW-80021) CFSTI: $1.00

Inreactor examination of the interior surface of the vertically oriented, Zircaloy-2 pressure tubes of the Plutonium Recycle Test Reactor revealed corrosion, termed fretting corrosion or fretting attack, at the points of contact between the fuel elements and pressure tubes. Examination of all of the 85 pressure tubes after the first year of power operation revealed approximately 1600 corrosion areas; 2.2% of the areas were deeper than 0.010 in. The maximum penetration observed was 0.026 in. Subsequent examinations show that although approximately 1700 new areas have been formed, the depth of penetration is decreasing. The decreased severity is attributed to use of increased contact area and decreased vibration. This report summarizes results of programs designed to detect and determine the extent of the inreactor attack and summarize results of out-of-reactor tests conducted to better define the attack. Possible mechanisms for the attack and conditions that result in deep penetrations are discussed. Author

N65-23295# Società Ricerche Impianti Nucleari, Saluggia (Italy).
SOME STUDIES CONCERNING STRUCTURE, RADIATION DAMAGE ANNEALING AND FISSION PRODUCT DIFFUSION IN PYROLYTIC CARBON
B. Chinaglia, M. Domenici, F. Pieragostini, and H. Walter 1964 38 p refs Presented at the 3d U. N. Intern. Conf. on The Peaceful Uses of Atomic Energy, Geneva, 31 Aug.–11 Sep. 1964
(Rept.-38)

As pyrolytic carbon (P.C.) can be considered intermediate between the amorphous and the crystalline state, it may present different degrees of order in its structure. It is felt that any measurement of physical properties should be correlated with a structural characterization. The structural parameters are determined in this work by neutron diffraction. This method demonstrated greater potential in the case of amorphous materials than the corresponding X-ray techniques. After this characterization the following were studied: (1) the recovery of electrical resistivity of samples irradiated at −195° C in a reactor; (2) the recovery of c-spacing and preferred orientation of identical samples irradiated at −195° C; (3) fission product diffusion in samples with equal characteristics. Author

N65-23296# Società Ricerche Impianti Nucleari, Saluggia (Italy).
STABILITY ANALYSIS AND DYNAMIC PERFORMANCE OF A CHEMICAL SYSTEM OPERATED FOR THE AUTOMATIC FINE CONTROL OF A NUCLEAR REACTOR
G. C. Ambrosini, T. Bozzoni, G. Cipollina, E. Colussi, and R. Garroni 1964 17 p refs Presented at the 3d U. N. Intern. Conf. on Peaceful Uses of Atomic Energy, Geneva, 18 Aug.–11 Sep. 1964
(Rept.-39)

Described is a neutron flux automatic control system, utilizing a soluble poison solution circulating in a tube located

in the reactor core, showing good stability characteristics and dynamic response. A prototype of this system was successfully tested on a swimming pool reactor. This report deals particularly with the dynamic characteristics of such a type of control and does not emphasize other kinds of problems, like those concerning the corrosion, the radiation damage, the boric acid recovery from the exhausted solution, and the poison deposition on the piping. Author

N65-23311# Hanford Atomic Products Operation, Richland, Wash.
METALLURGY RESEARCH OPERATION Quarterly Progress Report, Oct.–Dec. 1964
J. J. Cadwell et al 15 Jan. 1965 156 p refs
(Contract AT(45-1)-1350)
(HW-84573) CFSTI: $5.00

Research conducted under the *Physical Metallurgy, Reactor Metals Research, Chemical Metallurgy,* and *Materials Engineering* programs, is reported. Under the *Physical Metallurgy* program, studies on the combined effect of impurities and neutron irradiation on the properties and structure of single and polycrystalline specimens of molybdenum; and the mechanism of the β-α transformation of plutonium, are among those reported. Under the *Reactor Metals Research* program, such studies as the effects of irradiation upon the mechanical properties of nickel base alloys, irradiation damage to Zircaloy-2, fracture determinations, and damage mechanisms, are discussed. Under the *Chemical Metallurgy* program, studies include the effects of a water environment with hydrogen addition upon the behavior of zirconium alloys, ATR gas loop support, PRP materials development, production reactor corrosion and coating, N-reactor corrosion, and hybriding. Under the *Materials Engineering* program, studies on gas loop development, and PRTR pressure tube properties, are reported. Also included in the report are results of studies on N-reactor pressure tubes and low alloy steel pressure vessels. S.C.W.

N65-23334# Brookhaven National Lab., Upton, N. Y.
FACTORS IN THE ECONOMICS OF A SETTLED BED REACTOR
Jack Chernick Sep. 1964 40 p refs Sponsored by AEC
(BNL-909(T-372)) CFSTI: $2.00

The physical properties of a fast, settled bed reactor and their relation to power reactor economics are discussed. This fast breeder is cooled by liquid sodium that acts through downward flow to lock the fuel particles in place in a settled, randomly packed bed. This stability of a loosely settled, particulate bed under downward flow greatly increases fast reactor safety. The packed bed reactor can be fluidized by reversing the coolant flow during reactor shutdown for easing reconstitution. Fluidization of the core may achieve more uniform burnup and balance long-term reactivity effects. Both core and blanket can be refueled without mechanical handling of the fuel. The low sodium fraction and the absence of structure result in a hard neutron spectrum and higher breeding ratios of U^{238} fission, and make the fabrication of fuel elements of various shapes and sizes possible. Experiments to determine the distribution of 1/4-inch steel balls under manual vibration to obtain a truly randomly packed bed failed because of mismatch at the boundaries. The problem of forming beds of reproducible density was found of great importance. G.G.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-22280# Bege (J. R. M.) Co., Arlington, Mass.
THE CATENARY IN SPACE. FREE MOTIONS OF FLEXIBLE LINES
R. M. Langer Dec. 1964 91 p refs *Its* Rept.-6454
(Contract AF 49(638)-1327)
(AFOSR-64-2517; AD-611429)

The nature and importance of the catenary in space (flexible systems in one dimension) are discussed. Equations of motion are developed in more complete and universal form than in the literature. The catenary is described by means of a system of four, first-order, quasilinear, hyperbolic, partial differential equations. The special circumstances are treated where the first order system reduces to a standard second order wave equation familiar in the literature. The four characteristics of the hyperbolic system are found and also the vectors which help formulate combination variables suitable for the catenary problem. Some special solutions are presented for interesting catenary motions. A general treatment is formulated in terms of integral equations for the full catenary problem of planar motion with two independent variables and four dependent catenary parameters. Extensions to other novel problems are indicated. Author

N65-22277 Springfield Armory, Mass.
SURGE WAVES IN AUTOMATIC WEAPONS
Edwin H. Jakubowski and Henry P. Swieskowski *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 15–31 (See N65-22275 12-34)

It was observed that when an impact was imparted to a spring, the load was not distributed uniformly throughout the length of the spring and that some coils tended to oscillate. Furthermore, the stresses between adjacent coils were higher than those predicted by static considerations. Also, when a repetitive load was applied, the clashing of coils, which cause the rate of the spring to change, were observed. These observations indicated that a disturbance at the loaded end of the spring is propagated through the spring wire. Therefore, the propagation of the surge wave was considered. It was also observed that springs fabricated from stranded wire were superior to those fabricated from single wire in both endurance and fatigue tests. Basic formulas for the design of helical round wire springs are given. Both a graphical solution of the wave equation and a 10-cell finite difference representation for analog computer solution are presented. E.E.B.

N65-22316 Naval Research Lab., Washington, D. C. Mechanics Div.
A METHOD FOR EVALUATING TRANSDUCER LOADING EFFECTS ON ULTRASONIC TRANSIT TIME MEASUREMENTS
E. W. Kammer *In its* Report of NRL Progress 1965 p 1–5 refs (See N65-22315 12-34) CFSTI: $1.25

The effect of stress on the velocity of sound in a structural metal such as steel is considered. The stress effects, although measurable, were very small and other extraneous factors produced greater changes in the velocity of sound than the

stress. One of the factors, namely the transducer loading effects, was readily susceptible to investigation and evaluation and is discussed. The errors introduced by the necessary presence of the transducer can be eliminated with a data processing scheme which may be acceptable as an empirical definition for the unperturbed velocity as applied to conventional ultrasonic pulse data. Author

N65-22338# California Univ., Berkeley. Electronics Research Lab.
CONSOLIDATED QUARTERLY PROGRESS REPORT NO. 15, AUGUST 16 THROUGH NOVEMBER 15, 1964
D. J. Angelakos [1964] 145 p refs
(AD-460539)

Electronic research activities in the areas of bioelectronics, circuits, electron streams, plasmas, radiation and propagation, solid-state electronics, and on the characteristics of various systems are reviewed. Also included is a list of technical reports pertinent to the overall research effort. M.G.J.

N65-22412# Stanford Research Inst., Menlo Park, Calif.
THE FIELD OF CERTAIN ACOUSTIC RADIATORS Final Report
Joel L. Brenner and Vincent Salmon 31 Dec. 1964 56 p refs
(Contract Nonr-3947(00))
(AD-612280)

Calculations are performed to show directionality and similar properties in special acoustical fields. Tabulations are given of the fields of a radiating sphere or cylinder with one or two hot spots. Special noise fields are discussed, and graphs given showing the noise produced by a radiating line source, the energy of the noise being distributed along the radiating line in nonuniform manner. TAB

N65-22445# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF MEASURING COMPLEX PERMITTIVITY
V. S. Panchenko 30 Mar. 1965 6 p Transl. into ENGLISH from Russian Patent no. 156977 (Appl. no. 779217/26-9), 18 May 1962 2 p
(FTD-TT-65-76/1+2; AD-613457)

The object of invention was a method of measuring complex permittivity (dielectric constant) in a millimeter range of waves based on the measurement of the parameters of a reflected beam of electromagnetic waves directed at some angle to the surface of the specimen being investigated, which is distinguished by the fact that for the purpose of simplifying the process of the measurement and improving its precision, one changes the angle of incidence of the beam of electromagnetic waves on the surface of the specimen, determines the value of pseudo-Brewster angle, and finds the coefficient of reflection at this angle and computes the modulus of the permittivity and the angle of losses. TAB

N65-22450# Naval Ordnance Test Station, China Lake, Calif.
DEEP-SEA LIGHT-ATTENUATION MEASUREMENTS WITH A NULL-BALANCE TRANSMISSOMETER
Richard S. Hughes and Roswell Austin (Scripps Inst. of Oceanog., La Jolla, Calif.) Feb. 1965 16 p refs
(NOTS-TP-3748; AD-613017)

This report discusses an investigation into the volume attenuation coefficient of light in the sea, and also describes a newly developed null-balance transmissometer capable of measuring this coefficient of light to a depth of 2000 meters. Author

N65-22458# Air Force Systems Command, Wright-Patterson AFB, Ohio.
SPECTRAL CHARACTERISTICS OF SOME PRACTICAL VARIATIONS IN THE HALF-SINE AND SAWTOOTH PULSES Technical Report, 1 Feb.–1 Aug. 1964
Edward H. Schell Jan. 1965 65 p refs
(AFFDL-TR-64-175; AD-613024)

This analysis is a two part function composed of a ramp tangent to a half-sine pulse in which the rise-times and decay-times can be controlled independently of each other. Such a pulse is more representative of the physical condition present in a partially plastic, partially elastic shock machine such as the lead pellet types. The pulse is changed by increments from an ideal terminal peak sawtooth to an ideal half-sine. Positive and negative response spectra with a range of damping from zero to critical are presented. Fourier spectra are also presented. The report shows an important type of modal interaction failure which cannot be adequately excited with a symmetrical waveform even if testing is accomplished in both directions. Author

N65-22470# California Univ., Berkeley. Metal Processing Lab.
VISIOPLASTICITY Final Report
A. Shabaik, T. Altan, and E. G. Thomsen Feb. 1965 82 p refs
(Contract NOw-64-0070-d)
(AD-612913)

An effort was made to perfect the visioplasticity method for getting steady-state streamlines by using coordinate-measuring machines to obtain data, which are then processed by application of a computer; and to reanalyze potential theory in an attempt to discover by comparison with experiments if a theoretical solution for flow theories is possible. The visioplasticity techniques permitted the attainment of steady-state streamlines and some data were processed to yield velocities, strain rates and finite strain for extrusion problems. The programs are written in such a way that they may be applied to other die configurations. The theoretical analyses appear to show that the solution of an equivalent problem of a modified boundary shape obtained from the potential theory results in a flow net that is the best approximation to the actual flow net. Author

N65-22482# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
DEVELOPMENT OF SPECTRAL DISTRIBUTION SINGLE PULSE DETERMINATION TECHNIQUES FOR FIELD EMISSION FLASH X-RAY SYSTEMS
J. L. Brewster, F. J. Grundhauser, and A. Michelsen Apr. 1964 77 p refs
(Contract NOw-62-0604-c)
(CM-1044; AD-459025)

A simple, field adaptable, reliable method was developed for determination of the spectral intensity distribution of X-rays emitted during an individual pulse from flash X-ray tubes. The technique consists of obtaining X-ray absorption data, using copper step wedges as attenuators and a film-intensifier screen combination as a detector. A technique was developed for accurate intensity calibration of the film employing specially calibrated optical step wedges. The data thus obtained were analyzed by the Silberstein-Jones technique, obtaining a function which is the product of the flash X-ray spectrum and the spectral response of the detector employed. The flash X-ray spectrum thus obtained (employing a dosimeter detector of known spectral response) was compared with published data for conventional tubes at the same voltage. This flash X-ray spectrum, obtained with dosimeter detectors, was compared

with spectral functions obtained with copper step wedges and cassettes, providing a film-intensifier response function which was shown to agree reasonably well with calculated and measured response functions for similar screens. Author

N65-22491# Precision Instrument Co., Palo Alto, Calif. Research Div.
COHERENT LIGHT RECORDING TECHNIQUES Third Quarterly Report
Carl H. Becker, Siegfried Mohr, Robert J. Hull, and Edwin Hahn (California Univ., Berkeley) Griffiss AFB, N. Y., RADC, Feb. 1965 52 p refs
(Contract AF 30(602)-3272)
(RADC-TR-64-523; AD-613193)

The objective is to study and investigate techniques necessary for application of coherent light to the problem of high density wideband recording and readout, aimed at packing densities of information in excess of 10^{10} bits per square inch at frequency bandwidths of 100 Mc per second. The study concentrates on photographic coherent light recording. Research results are reported. Research efforts were directed towards complete evaluation of maximum achievable bit rate and information density with photographic coherent light recording. The theoretical analysis of electric deflection methods of coherent laser beams was reported. Author

N65-22580*# National Aeronautics and Space Administration, Washington, D. C.
ON AN ORTHO-INTERPOLATIVELY AVERAGED VARIANT OF THE RESTRICTED THREE BODY PROBLEM
N. D. Moiseyev May 1962 28 p refs Transl. into ENGLISH from Tr. Gos. Astron. Inst. (Moscow), v. 28, 1960 p 9–23
(NASA-TT-F-8222) CFSTI: HC $2.00/MF $0.50

The basic theory of the ortho-interpolatively (or closed interpolatively) averaged variant in the differential equations of motion for the restricted three-dimensional circular three-body problem is discussed. The Delaunay interpolative elements of these equations are calculated. A double average based on two mutually conjugate interpolative elements is developed and integrals are claculated. The conditions for ortho-interpolation and their relationship to the Tisserand criterion are discussed. The conditions are satisfied for many comets and asteroids of the Jovian group. The differential equations of perturbed motion in the ortho-interpolatively doubly averaged variant of the restricted three-body problem are integrated, and triple average based on two mutually conjugate and one self-conjugate interpolative elements is integrated. A simpler formula for the Hamiltonian results. L.S.

N65-22620*# National Aeronautics and Space Administration, Washington, D. C.
STRESS ANALYSIS BY THE OPTICAL METHOD [OB ISSLEDOVANII NAPRYAZHENIY OPTICHESKIM METADOM]
V. L. Ginsburg Apr. 1965 22 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 14, no. 3, 1944 p 181–192
(NASA-TT-F-9327) CFSTI: HC $1.00/MF $0.50

The use of artificial anisotropy produced by stresses in an isotropic body is discussed. The influence of direction and change of direction and interrelationships of waves are discussed. The solution of light diffusion problems is explained in detail, as well as diffusion-connected changes and problems of axis rotation. Author

N65-22638# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
SOUND PROPAGATION THROUGH A WINDY ATMOSPHERE
Henry Rachele and Doyle Mathews Ft. Monmouth, N. J., Army Electron. Command, Apr. 1965 18 p refs
(ERDA-302; AD-461169)

This report presents derivations and evaluations of equations, derived from a ballistics viewpoint, used for ray tracing of sound through a windy atmosphere. A solution to the differential equation is outlined which is highly adaptable to computer use, and satisfies Snell's Law for both the wind case and the no-wind case. Results of using the simple equation (solution of the differential equation) and four digital computer programs, involving different integration techniques for solving the differential equations are presented. Author

N65-22654# Suffield Experimental Station, Ralston (Alberta).
PRECURSOR SHOCKS PRODUCED BY A LARGE YIELD TNT EXPLOSION
John M. Dewey Mar. 1965 16 p refs Presented at the Ann. Meeting of the Fluid Dyn. Div. of the Am. Phys. Soc., Pasadena, Calif., 23–25 Nov. 1964
(Suffield-SP-48)

Precursor shocks, normally associated with surface burst or low-level nuclear explosions, have been explained as effects of the intense thermal radiation produced by a nuclear explosion, although an alternative theory suggests that the primary cause may be a ground surface wave, with some enhancement by a strong thermal gradient. In July 1964, a 500-ton TNT surface burst charge was detonated. High speed photographs of the explosion show that along a limited number of radii, dust clouds moved out ahead of the main shock, and that those clouds were enveloped by a shock wave. Some of these dust clouds reached a height of about 50 ft before arrival of the main shock. High speed films taken from a position close to the charge show that, in some regions near to the ground, the precursor is downwind facing, and a Mach stem appears to have been produced. In all cases the precursors originated along well-compacted earth roadways running radially from the charge center. Author

N65-22698# Emmanuel Coll., Boston, Mass. Research Language Center
COHERENCE PROPERTIES OF ELECTROMAGNETIC RADIATION
Chih-chiang Wang Bedford, Mass., AFCRL, May 1964 48 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), no. 19, 1963 p 320–335
(Contract AF 19(628)-3869)
(E-T-Ch-64-12; AD-611030)

This paper primarily discusses recent progress in research dealing with coherence properties of electromagnetic radiation. Using the concept of photon degeneracy and the degree of coherence, problems such as interference, intensity fluctuations and the properties of coherent light sources are explained. Since the radiation process is random, the intensity of the signal generated by the interference of different sources can be determined by the correlation of radiation processes as derived in this paper. Treating photons as bosons, the phenomenon "intensity interference" is explained as quantum fluctuations. Thus, the coherence properties of radiation may well be interpreted from the basic concept of quantum mechanics. Author

N65-22754 Aberdeen Proving Ground, Md. Ballistic Research Labs.
MODAL ANALYSIS OF TRANSIENT VIBRATION PROBLEMS IN LINEARLY VISCOELASTIC SOLIDS
Alexander S. Elder *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 301–315 refs (See N65-22732 12-34)

The thesis is presented that the transient vibration problems of linear viscoelasticity may be solved by means of the Sturm–Liouville theory provided the homogeneous boundary conditions for the free vibrations can be combined to give a characteristic equation with real roots. Further, it is shown that if these conditions do not hold, the Cauchy contour integrals provide a more general type of solution. Formal solutions of two dynamic problems are achieved by this method. The case of the torsional spring added to the torsional pendulum, and the case of radial vibrations of a sphere subject to certain specified boundary conditions are considered. Transient vibrations of these types can be solved by contour integrals, which may be evaluated by residue theory or reduced to a Fourier integral by a change of variable. E.E.B.

N65-22833# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
DETERMINATION OF ENERGY RELEASE RATE FOR BIAXIAL BRITTLE FRACTURE SPECIMEN
A. J. Bush and W. K. Wilson Aug. 1964 32 p refs
(Contract NObs-78844)
(WERL-8844-2; AD-611659)

A compliance study was made on a 4X biaxial specimen to determine the numerical factor in the expression used for the energy release rate for the biaxial brittle fracture specimen developed previously. The variation of the numerical factor with crack length or notch depth was also determined. For the standard geometry specimen, the factor was found to be 0.722. This value is approximately the same as that determined in another recent study at the research laboratories. Author

N65-22855*# National Aeronautics and Space Administration, Washington, D. C.
ON THE LINES OF FORCE OF A MAGNETIC FIELD [O SILOVYKH LINIYAKH MAGNITNOGO POLYA]
V. K. Mel'nikov Jul. 1962 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 144, no. 4, Jun. 1962 p 747–750
(NASA-TT-F-8263) CFSTI: HC $1.00/MF $0.50

Investigated were the plasma boundary separating regions with different line of force behavior as one of the causes of protuberances leading to plasma instability. Considered is an irrotational magnetic field designated by the scalar potential $H_0 z + \Psi(x,y,z)$, where H_0 is a constant, and the function $\Psi(x,y,z)$ satisfies the Laplace equation periodic along z. The line of force equations for that field are developed with the help of conveniently selected substitutions. The share of solutions depends on the value of the cut cross section of the system's separatrix and the cross section of the separatrix of the system obtained by substitution. Also considered is the disposition of the lines of force of a three-threaded helical field that is perturbed by a corrugated field. G.G.

N65-22917# California Univ., Livermore. Lawrence Radiation Lab.
PHYSICS DEPARTMENT PROGRESS REPORT, OCTOBER 1964–JANUARY 1965
A. Lorenz, ed. [1965] 94 p refs
(Contract W-7405-ENG-48)
(UCRL-12473) CFSTI: $3.00

Progress was reported in nuclear and atomic physics, thermodynamic properties of matter, fluid and hydrodynamics, radiation physics, and mathematical and computational methods. Among the specific items covered were the measurements of the absolute differential cross sections for the ground state neutrons from 0° to 160° using polyethylene long counters. These measurements were done from 5.79 to 6.88 MeV, from 5.95 to 7.29 MeV, and from 6.49 to 7.60 MeV for Al, Si^{29}, and P^{31}, respectively. Also, the $F^{19}(d,\alpha)O^{17}$ reaction was measured at 5.5, 6.5, 7.5, 8.5, 9.5, and 11.5 MeV for the ground state and the four first excited states of O^{17}. The alpha particles were detected using surface barrier silicon detectors. The absolute differential cross sections were measured from 7.5° to 163°. Three angles were measured simultaneously using three detectors mounted on an arc of a circle 10° apart. Further, the low-lying level structure of S^{31} and Ne^{19} was studied by means of the reactions $P^{31}(p,n)S^{31}$ and $F^{19}(p,n)Ne^{19}$, respectively. The $F^{19}(p,n)Ne^{19}$ confirmed the existence of a triplet at 1.5 MeV and established the existence of a previously unreported multiplet of levels at an excitation energy of 3.35 MeV. E.E.B.

N65-22955# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
PLANE WAVES IN AN ELASTIC-PLASTIC HALF-SPACE DUE TO COMBINED SURFACE PRESSURE AND SHEAR
Hans H. Bleich and Ivan Nelson Jan. 1965 75 p refs
(Contract Nonr-266(86))
(TR-36; AD-612107)

The most general case of plane-wave propagation, when normal and shear stresses occur simultaneously, is considered in a material obeying a certain yield condition. The resulting nonlinear differential equations have not previously been solved for any boundary value problem, except for special situations where the differential equations degenerate into linear ones. In this paper, the stresses in a half-space, due to a uniformly distributed step load of pressure and shear on the surface, are obtained in closed form. Author

N65-23039# General Technology Corp., Elgin, Ill.
A SURVEY OF AERODYNAMIC NOISE
J. D. Ingram Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1964 51 p refs
(Contract AF 33(657)-10945)
(FDL-TDR-64-132; AD-611173)

A representative survey of the current literature concerning aerodynamic noise was made. It was found that much of the research done in this field is either experimental or semi-empirical. This is due primarily to the complex nature of the theory of turbulence. Author

N65-23040# General Technology Div., Elgin, Ill.
THEORETICAL STUDIES OF METHODS OF GENERATING RANDOM WAVES FROM HARMONIC SOURCES
J. C. Samuels Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1964 37 p refs *Its* Tech. Rept.-4-2
(Contract AF 33(657)-10945)
(FDL-TDR-64-133; AD-611174)

This report is concerned with the approximation of acoustical noise fields by the use of modulated pure tone sources. Given a specific random signal the methods of orthogonal expansion and Fourier expansion are studied. The integral equation arising from the orthogonal expansion is solved for the normal functions when the power spectrum is given as the

ratio of two polynomials, Markoff Autocorrelation function, stationary band limited Gaussian white noise of mean zero, band limited stationary normal white noise on a finite interval, and white noise. Deterministic and random frequency, and amplitude modulation and random switching are examined as ways to broaden spectral components. Author

N65-23123# Texas Technological Coll., Lubbock. School of Engineering
DIMENSIONAL ANALYSIS SIMPLIFICATION OF VENTURI METER COMPUTATIONS
John Finis Frazier (M.S. Thesis) May 1965 65 p refs
(AD-611792)

Through the use of dimensional analysis dimensionless parameters were developed which simplify computation of mass flow rates of a fluid through a pipe, as measured by a Venturi meter. Numerical values for new parameters were obtained for various size Herschel-type Venturi meters; and plot of representative curve led to development of an equation for direct mass flow rate determination. Author

N65-23214# Stanford Univ., Calif. Div. of Engineering Mechanics
ON VARIATIONAL PRINCIPLES IN FINITE ELASTICITY
Nai-chien Huang Mar. 1965 24 p refs
(Contract Nonr-225(69))
(TR-154; AD-462075)

Two variational principles are formulated for the theory of finite elasticity. The first variational principle is an extension of Hu and Washizu's variational principle and the second is a generalization of the theory of stationary potential energy in classical elastostatics. New variational variables are introduced. The Euler equations are Rivlin's field equations expressed in terms of undeformed state variables for the theory of finite elasticity. Three examples are solved by the variational technique for illustrative purposes. Author

N65-23339# Maryland Univ., College Park. Dept. of Physics and Astronomy
ON THE POSSIBILITY OF LONG-RANGE SPIN POLARIZATION IN A DEGENERATE ELECTRON GAS
A. Bardasis, D. S. Falk, R. A. Ferrell, M. S. Fullenbaum, R. E. Prange et al Jan. 1965 9 p refs
(TR-434)

The conclusion that it is possible under certain circumstances for an induced long-range spin density to exist in a nonferromagnetic metal was reexamined to reconcile it with the theory that the spin density generated at large distances from a localized spin perturbation is of an oscillatory nature. Considered in the evaluation was the additional spin density contributed by the nonevanescing waves to a long-range polarization thereby canceling the polarization from the evanescing waves. This outcome was confirmed by the presented calculations which showed that the spatial dependence of the excess spin density resulting in a nonferromagnetic electron gas from contact with a ferromagnetic one is entirely of an oscillatory type. G.G.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-22427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PERTURBATION OF THE THERMAL EQUILIBRIUM DISTRIBUTION IN THERMAL DISSOCIATION OF DIATOMIC MOLECULES
E. E. Nikitin 24 Mar. 1965 17 p refs Transl. into ENGLISH from Zh. Fiz Khim. (Moscow), v. 33, no. 3, 1959 p 572–580
(FTD-MT-64-468/1; AD-613450)

For an harmonic oscillator with a finite number of discrete levels the decomposition rate constant depends upon the probability of transition of the oscillator in the discrete spectrum $P_{n,n\pm1}$ and upon the probability of transition to the continuous spectrum P_{∞}. In actual cases when P_{∞} is sufficiently large in comparison with P_{10} the rate of decomposition is determined by the rate of delivery of low energy level molecules to the dissociation threshold. The maximum value of the preexponential factor is here of the order of the number of collisions. The distribution function for decomposing oscillators for periods greater than the time of relaxation of the vibration energy $1/k_0$ decreases exponentially. With increase in energy it decreases more rapidly than the Boltzman function $\exp(-E/kT)$, tending to zero for the last discrete level, when the decomposition rate constant, depending upon P_{10} and P_{∞}, attains its maximum value. The fraction of molecules decomposing in the time $t \approx 1/k_0$, which were initially at a lower temperature, is less than the ratio between the time of relaxation and the characteristic time of reaction. The remaining molecules decompose according to an exponential law with the characteristic time $1/k$. Author

N65-22473# Varian Associates, Beverly, Mass.
THALLIUM BEAM TUBE RESEARCH Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Richard F. Lacey [1964] 22 p refs
(Contract DA-28-043-AMC-00350(E))
(QPR-2; AD-612933)

Several hot wire ionizers were tested, including oxidized and carbonized tungsten and iridium. Tests up to now fail to confirm the large ionization efficiency of iridium for thallium reported by Shipley. No ionizers of reasonable efficiency have yet been found except for the well-known oxidized tungsten hot wire ionizer. A test cylindrical cavity whose central rod is supported by an uncoated quartz continuation was designed. A prototype quadrupole magnet was designed. Beam optics calculations have been completed. Author

N65-22487# Chicago Univ., Ill. Dept. of Physics
LABORATORY OF MOLECULAR STRUCTURE AND SPECTRA Quarterly Status Report, 1 Oct.–31 Dec. 1964
Clemens C. J. Roothaan [1964] 7 p
(Contract DA-11-022-ORD-3119; ARPA Order 368)
(QSR-22; AD-457076)

The following topics are discussed: *General Atomic and Molecular Programming*—basic subroutines for quantum chemistry program library; *Theoretical Developments and Calculations on Atoms*—calculations on first row atoms and on the dipole polarizabilities of two- and four-electron atom systems, and the form of relativistic Hamiltonian for atoms; *Hartree-Fock Calculations and the Electronic Structure of Diatomic Molecules*—first row homonuclear diatomic molecules, first and second row diatomic hydride molecules, and repository calculations; *One-Center Expansion SCF Calculations on Molecules Possessing C_{3v} Symmetry*—calculations on NH_3; and *Limited Configuration-Interaction Calculations for Homonuclear Diatomic Molecules*—research on H_2, Li_2, and F_2. G.G.

N65-22498# Argonne National Lab., Ill.
INSIDE QUANTUM FIELD THEORY AND LECTURES ON NEUTRINO INTERACTIONS
Frank Chilton (Stanford Univ.) Dec. 1964 34 p
(Contract W-31-109-ENG-38; Grant AF-AFOSR-62-452)
(ANL-6989) CFSTI: $2.00

A review and summary of the fundamental ideas of quantum field theory are presented with emphasis on those features that are relevant to application. Consideration of second quantization is omitted because quantum mechanics is fully contained in the wave equations. The momentum-energy relation for free particles is used to develop the wave equation for spin zero, and subsequently the wave equations for spin one-half the plane wave solution, and the spin sums corresponding to the positive and negative energy projection operators in noninteracting fields. The inclusion of the Lagrangian is used in calculations of interacting fields. Calculations on neutrino interactions and hyperon production in an SU_3 model are also presented. G.G.

N65-22500# Radiation Research Associates, Inc., Fort Worth, Tex.
GAMMA-RAY ENERGY AND ANGULAR DISTRIBUTIONS ABOVE AN INFINITE FALLOUT FIELD
R. L. French 1 May 1964 96 p refs
(Contract DA-49-146-XZ-254)
(RRA-T43; AD-612030)

Monte Carlo techniques were applied in a detailed study of the gamma radiation environment produced in air three feet above fallout uniformly distributed on a smooth ground surface. The basic computations included the energy and angular distributions of the scattered photon flux above monoenergetic plane isotropic gamma-ray sources for ten different source energies from 0.10 to 3.5 MeV. For each source of energy, the flux arriving at the receiver in each of ten energy intervals between 0.04 and 3.5 MeV and eighteen equal receiver angle intervals between 0° (nadir) and 180° (zenith) was calculated. Separate calculations were performed for the uncollided fluxes from the infinite plane isotropic source. The results of the monoenergetic calculations were combined to obtain energy and angular distributions of the photon flux from fallout of four different ages: 1.12 hours, 23.8 hours, 4.57 days, and 9.82 days. Comparisons with measured and previously calculated data, both for actual fallout fields and for simulated infinite plane sources, show favorable agreement. Author

N65-22503# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics
SPIN POLARIZATION EFFECT AND THE MAGNETIC MOMENTS OF ODD-A DEFORMED NUCLEI
Z. Bochnacki and S. Ogaza Nov. 1964 18 p refs Submitted for Publication
(Rept.-361)

The effect of the spin polarization of the even–even core on magnetic moments of odd-A deformed nuclei is discussed. The comparison of the measured and calculated values of the effective spin g-factor shows that the spin polarization explains quite well the observed reduction of g_s from its free-nucleon value. Author

N65-22505# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
AGGLOMERATION OF HELIUM, RECRYSTALLISATION AND AGEING IN IRRADIATED ALUMINIUM–LITHIUM ALLOYS
E. Kamienski and W. Malinowski Aug. 1964 16 p refs
(Rept.-546/XIV)

Aluminium containing 0.1; 0.25; 0.69; 1.75; 2.5 and 2.7 wt% lithium was irradiated to 10^{19}n/cm^2. Agglomeration of helium at the grain boundaries of alpha alloys and their recrystallization was investigated. As is indicated by the measurements of microhardness, age hardening of alpha plus beta alloys occurs in the reactor. Author

N65-22508# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
THE STOPPING POWER OF D_2O FOR LOW ENERGY PROTONS
Edward Rurarz Oct. 1964 24 p refs
(Rept.-556/IA)

The stopping power of D_2O for low energy protons, 18–550 keV, was calculated using a method introduced by Gryzinski. This theory gives very good agreement with the experimental results of Reynolds, Phillips and Wentzel and Whaling. Author

N65-22516# Emmanuel Coll., Boston, Mass. Research Language Center
A COMPARATIVE STUDY OF THE HETEROGENEOUS PERTURBATIONS BETWEEN THE STATES $B^1\Sigma_u^+$ (2p) AND $C^1\pi u$ (2p) IN THE MOLECULES H_2, HD, AND D_2; AND THE ISOTOPIC EFFECT OF THE λ-DOUBLING IN THE STATE $C^1\pi u$ (2p) OF THE MOLECULES H_2, HD, AND D_2 [ETUDE COMPARATIVE DES PERTURBATIONS HETEROGENES ENTRE LES ETATS $B^1\Sigma_u^+$ (2p) ET $C^1\pi u$ (2p) DANS LES MOLECULES H_2, HD ET D_2; ET EFFET ISOTOPIQUE DU DEDOUBLEMENT λ DANS L'ETAT $C^1\pi u$ (2p) DES MOLECULES H_2, HD ET D_2]
André Monfils Mar. 1964 36 p refs Transl. into ENGLISH from Bull. Classe Sci., Acad. Roy. Belg. (Brussels), v. 48, 1962 p 460–489
(Contract AF 19(604)-8505)
(E-T-FC-64-2; AD-456861)

The heterogeneous perturbations between the levels of the $B^1\Sigma_u^+$ state and the levels of the $C^1\pi u$ state are computed for the molecules HD and D_2. The constants obtained are compared with each other and with those published earlier for H_2. The isotopic effect is found to be in qualitative agreement with Kronig's formula

$$W_{12} = \frac{h^2\sqrt{J(J+1)}}{8\pi^2\mu R_e^2}$$

Author

N65-22525 European Organization for Nuclear Research, Geneva (Switzerland). Accelerator Research Div.
AUTOMATIC TUNING OF THE ACCELERATING CAVITIES OF THE CERN PROTON LINEAR ACCELERATOR
P. Bramham 1 Mar. 1965 51 p refs
(CERN-65-9)

A servosystem is used to vary the tuning of each cavity of the linear accelerator (which injects protons into the CERN Proton Synchrotron) in order to keep a chosen phase relationship between the field in the cavity and a radiofrequency reference common to all cavities. Descriptions are given of the connections to the cavities, the phase-sensitive bridges, the storage of information between the pulses of radiofrequency power, and the arrangements for applying the error signal to a motor which moves a part of the cavity wall. The servosystem is analyzed by means of the Bode diagram. Author

N65-22526# Radiation Research Associates, Inc., Fort Worth, Tex.
GAMMA-RAY ENERGY AND ANGULAR DISTRIBUTIONS NEAR THE AIR/GROUND INTERFACE FROM PLANE FALLOUT AND POINT Co^{60} SOURCES
R. L. French and C. W. Garrett (Armed Forces Radiobiol. Res. Inst.) 1 Jun. 1964 30 p refs Presented at the Ann. Meeting of the Health Phys. Soc., Cincinnati, 15–18 Jun. 1964
(Contract DA-49-146-XZ-254)
(RRA-M42; AD-612029)

Monte Carlo techniques were applied in a detailed study of the gamma radiation environment three feet above the air/ground interface due to two types of gamma ray sources: (1) fallout uniformly distributed on the ground surface, and (2) a Co 60 point source also three feet above the ground at separation distances of 100 to 800 feet. In each case, the scattered and direct-beam fluxes were computed in each of ten receiver energy intervals between 0.04 and 3.5 MeV and eighteen equal receiver angle intervals between 0° (nadir) and 180° (zenith). All results were integrated over azimuthal angle at the receiver to reflect distribution in polar angle only. The source energy was used as a parameter in the fallout calculations and the results thus computed for each of ten different source energies may be weighted and combined to obtain data for fallout of any desired age. Comparisons of the Monte Carlo data with measured data and with other calculated data, both for fallout and for Co 60 point sources, show favorable agreement. Author

N65-22548*# Florida Univ., Gainesville.
THEORY OF INTERNAL RELAXATION IN CHEMICAL KINETICS
G. Ludwig Hofacker 15 Jan. 1965 46 p refs *Its* Preprint No. 66
(Grant NsG-512)
(NASA-CR-62397) CFSTI: HC $2.00/MF $0.50

For molecular systems with a relatively small number of degrees of freedom, internal relaxation processes are described by a nonhomogeneous master equation for nondiagonal elements of the density matrix. The theory is applied to internal vibrational relaxation and intramolecular rearrangement (isomerization) reactions. The general character and certain types of solutions of the master equation are investigated. Author

N65-22619*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF INTENSITIES IN THE VACUUM SPECTRAL REGION [IZMERENIYE INTENSIVNOSTEY V VAKUUMNOY OBLASTI SPEKTRA]
Ye. Ya. Shreyder Apr. 1965 51 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 12, 1964 p 2089–2111
(NASA-TT-F-9317) CFSTI: HC $2.00/MF $0.50

Methods of performing absolute and relative intensity measurements in the vacuum ultraviolet are discussed. Reasons for difficulties in performing calibrations, and the advantages of use of the synchrotron for comparison of radiation are explained. Drawbacks and advantages of continuous calibration of the entire system are stated. Preference of open photomultipliers and gas-filled ionization chambers are included. Author

N65-22677# Michigan Univ., Ann Arbor. Dept. of Physics
HIGH ENERGY π + p ELASTIC SCATTERING FOR SMALL MOMENTUM TRANSFERS AND FORWARD DISPERSION CALCULATIONS Technical Report No. 19
Howard I. Saxer (Ph.D. Thesis) Dec. 1964 94 p refs
(Contract Nonr-1224(23))
(Rept.-03106-19-T; AD-611133)

The negative pion-proton elastic differential cross-section was measured at incident pion momenta of 2.01, 3.15, 4.13, and 4.95 BeV/c for the range of the square of the four momentum transfer of 0.0008 < or = absolute value T < or = 0.154 $(BeV/c)^2$. The data extended into the region where Coulomb scattering contributions were significant. Experimental values for the real part of the forward nuclear scattering amplitude were calculated using a simple interference model for Coulomb nuclear interaction. The best values found are consistent with dispersion theory predictions in that the sign is negative, indicating destructive interference. Forward dispersion relation calculations were carried out for pion kinetic energies of 1 to 29 BeV using recent pion (=) + P total cross section results. Author

N65-22697# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AN ESTIMATE OF THE ABSORPTION MEAN FREE PATH FOR A PHOTON IN A GAS
H. E. Moses 4 Feb. 1965 17 p refs *Its* Group Rept. No. 1965-13
(Contract AF 19(628)-500; ARDA Order 600)
(ESD-TDR-65-42; AD-611576)

A photon which is emitted by an excited atom is considered, the atom being surrounded by like atoms in the ground state. An estimate is made of how far the photon can travel before it is absorbed by a ground-state atom. The selection rules of the atom are used, and the Doppler shift in energy and angular momentum of the photon is taken into account. A discussion is presented which indicates how the mean free path gives an indication of whether or not the gas is optically thick. On the basis of the formula which is derived for the mean free path, it is shown that, in general, gases are more transparent to the shorter wavelengths than to the longer ones. TAB

N65-22708# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
MEASUREMENT OF ATMOSPHERIC ION REACTIONS Yearly Technical Summary Report, Aug. 1, 1963–Jul. 31, 1964
R. F. Stebbings, M. A. Fineman, J. W. Mc Gowan, B. R. Turner, V. A. J. van Lint et al 25 Jan. 1965 168 p refs
(Contract DA-49-146-XZ-041)
(GA-5615; DASA-1573; AD-610869)

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2. A CROSSED BEAM INVESTIGATION OF N_2D^+ COLLISIONS B. R. Turner, M. A. Fineman, and R. F. Stebbings 34 p refs (See N65-22710 12-24)

3. MICROWAVE INVESTIGATIONS OF AFTERGLOWS V. A. J. van Lint and M. E. Wyatt 90 p refs (See N65-22711 12-24)

4. TECHNIQUES FOR STUDYING ELECTRONS DURING AFTERGLOWS V. A. J. van Lint, J. Parez, D. Trueblood, and M. E. Wyatt 41 p refs (See N65-22712 12-24)

N65-22709 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
ION REACTIONS WITH CROSSED BEAMS AND MASS SPECTROMETRY OF AFTERGLOWS

R. F. Stebbings, M. A. Fineman, J. W. Mc Gowan, and B. R. Turner *In its* Meas. of Atmospheric Ion Reactions 25 Jan. 1965 36 p refs (See N65-22708 12-24)

Progress was made in three major aspects of the program. Charge transfer and charged rearrangement collision cross sections were measured at energies down to 2 eV with identification of product ions and some state selection of primary ions. Electric impact studies of molecular oxygen with high resolution provided new important information on the ionization process, while investigations of negative ions in afterglows of atmospheric gases demonstrated the comparative lack of understanding in this important aspect of atmospheric deionization. Author

N65-22710 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science

A CROSSED BEAM INVESTIGATION OF N_2D^+ PRODUCTION IN $N_2^+-D_2$ COLLISIONS, APPENDIX

B. R. Turner, M. A. Fineman, and R. F. Stebbings *In its* Meas. of Atmospheric Ion Reactions 25 Jan. 1965 34 p refs Submitted for Publication (See N65-22708 12-24)

The reaction $N_2^+ + D_2 \rightarrow N_2D^+ + D$ was studied in a crossed beam experiment. The angular distribution of the secondary ions was determined with a movable quadrupole mass filter. These measurements show that the reaction proceeds by complex formation rather than by direct collision. Differential cross sections were obtained within the energy range 7.5 to 57.5 eV. Total cross sections for this reaction were determined using another crossed beam apparatus in which the product ions are collected in toto. Total cross sections were also derived from the angular measurements but less reliance is placed on these values. Author

N65-22711 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science

MICROWAVE INVESTIGATIONS OF AFTERGLOWS

V. A. J. van Lint and M. E. Wyatt *In its* Meas. of Atmospheric Ion Reactions 25 Jan. 1965 90 p refs (See N65-22708 12-24)

The following reactions were studied by the ionization afterglow technique: ionic recombination in O_2; thermalization diffusion and electron–ion dissociative recombination in N_2; attachment in gases containing NO_2; attachment and electron–ion dissociative recombination in gases containing NO. Author

N65-22712 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science

TECHNIQUES FOR STUDYING ELECTRONS DURING AFTERGLOWS

V. A. J. van Lint, J. Parez, D. Trueblood, and M. E. Wyatt *In its* Meas. of Atmospheric Ion Reactions 25 Jan. 1965 41 p refs Submitted for Publication (See N65-22708 12-24)
(Contracts AF 29(601)-1225; AF 29(601)-2779)

Ionization afterglow techniques involve production of electron–ion pairs in a gas by a short pulse of high-energy nuclear radiation, 10- to 30-MeV electrons in this case. The electron density and electron–atom collision frequency are measured by passing through the dilute plasma a microwave signal whose amplitude and phase shift are measured with a microwave detector in a bridge configuration. An X-band microwave cavity and a 300-Mc/sec cavity were also used in performing measurements with higher sensitivity at lower pressures. Results of these experiments include determinations of electron attachment and electron–ion recombination coefficients as well as momentum and energy transfer cross sections. Examples from studies of momentum and energy transfer, as well as electron–ion recombination in nitrogen, are presented. Author

N65-22722 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HETEROGENEOUS RECOMBINATION OF ATOMIC GASES. REACTION OF HYDROGEN ATOMS WITH THE SURFACE OF MOLYBDENUM

V. A. Lavrenko and I. N. Frantsevich *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 216–227 refs (See N65-22713 12-30)

The velocities of space vehicles (satellites, spacecraft) are such that the time spent by gas particles near the surface of the vehicle's skin may be comparable with the times required for completion of particle dissociation and recombination processes at its surface. As a result, the local value of the heat flow onto the body is determined to a considerable degree by the rate of the heterogeneous chemical recombination reaction of the corresponding atomic gas on the catalytically active surface of the material. An experimental study is reported of the kinetic interaction of hydrogen atoms with a pure molybdenum surface in the temperature range from 100° to 850°, with the atomic gas at pressures of 0.005 to 0.05 mm Hg. The corresponding values of the heterogeneous recombination coefficients $\gamma_{H/Mo}$ were calculated. Author

N65-22752 White Sands Missile Range, N. Mex. Nuclear Effects Lab.

RETROFUGAL ELECTRON FLUX FROM MASSIVE TARGETS IRRADIATED WITH A MONOENERGETIC PRIMARY BEAM

Ralph W. Dressel *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 275–288 refs (See N65-22732 12-34)

An electron beam of finite cross section upon entering a solid target spreads due to scattering. Apparently, most of the electrons that form the retrofugal flux issue from a region having a diameter of less than one-half the electron range in the material. The distribution and orientation of these electrons that work back out of the target face to form the retrofugal flux are discussed in detail. Data on the dependence of the flux coefficient for beryllium and uranium are given in terms of the electron energy and the angle between the detector axis and the target surface normal. Also, changes in the angular distribution of the retrofugal electrons from low Z-targets are shown. Further, a family of curves are presented for the differential retrofugal flux coefficient. A comparison of results is made by superimposing experimental data upon curves of calculated and experimental values reported by previous investigators. E.E.B.

N65-22829# Emmanuel Coll., Boston, Mass.

THE PROBLEM OF AMBIGUITY IN THE PHASE SHIFT ANALYSIS OF SCATTERING PROCESSES

Nien-Ning Huang Bedford, Mass., AFCRL, Jun. 1964 35 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 5, 1963 p 306–319
(Contract AF 19(628)-3869)
(E-T-CH-64-13; TT-65-61679; AD-611028)

Starting from the conditions which should be satisfied by the existence of different choices in phase-shift analysis, this paper discusses the general ambiguity in the analysis of elastic scattering of particles with arbitrary spins. The transformation matrices among the different sets of phase shifts are given, and the real parameters involved are determined by the system of second-order algebraic equations. The problem of ambiguity

in the phase-shift analysis therefore is reduced to finding the real roots of these equations. The number of different sets of real roots is twice that of the different choices in the phase shift. Therefore, generally kinematic ambiguity in phase-shift analysis is solved. The ambiguity in the phase-shift analysis corresponds to the spin motion which conserves the components of spin tensors in the direction of momentum, and the parameters which characterize this type of general spin motion take fixed values. From the properties of the algebraic equations, it is proposed that the ambiguity in cases of whole integral spin is much less than in cases of half integral spin. TAB

N65-22842# Società Ricerche Impianti Nucleari, Saluggia (Italy).
A POSSIELE USE OF ABSORPTION FILTERS IN THE DIFFRACTION OF NEUTRONS [UN POSSIBLE EMPLOI DE FILTRES D'ABSORPTION EN DIFFRACTION DE NEUTRONS]
M. Domenici 1963 10 p refs In French Presented at the Congrés Intern. sur la Diffusion et la Diffraction des Neutrons, Grenoble, France, 3–5 Sep. 1963
(Rept.-9)

A filter is described that permits the separation of higher order harmonics in a monochromatic bundle of neutrons. Using this filter, very small wavelengths can be obtained which, in certain diffraction apparatuses, represent the only possibility of making investigations up to very large angles.
Transl. by M.P.G.

N65-22919# Rochester Univ., N. Y. Dept. of Physics and Astronomy
A NOTE ON A DIFFICULTY WITH THE Ũ (12) S-MATRIX THEORY
L. K. Pandit Riazuddin and S. Okubo 24 Mar. 1965 11 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-79)

Discussed is the difficulty of considering a noncompact group Ũ(12) as an invariance group for the S-matrix because of the incompatibility of the Ũ(12) invariance with the crossing symmetry of the S-matrix. It was observed that the unitary and crossing symmetry difficulties stem from the noninvariance under Ũ(12) of the Bargmann–Wigner equations which really determine the noninvariant charge-conjugation relations. G.G.

N65-22921# Rochester Univ., N. Y. Dept. of Physics and Astronomy
A STORAGE RING FOR 10 BEV/C MUONS
John Tinlot and Daniel Green 10 Mar. 1965 15 p
(Contract AT(30-1)-875)
(UR-875-76)

A strong focusing ring is being constructed of magnets whose function is to trap muons of 5 to 10 BeV, and to study the interaction of the trapped particles in targets placed in the ring. It is shown that such a ring is especially suitable for use with the Stanford linear accelerator because of the hundredfold increase in effective duty cycle. Other advantages of the scheme are that the muons are nearly monoenergetic, free of contamination, well collimated, and confined to a small beam, well suited for performing scattering experiments. Typical parameters of the trapping ring are presented. Author

N65-22922# California Univ., Berkeley. Lawrence Radiation Lab.
SPIN AND DECAY PARAMETERS OF THE Ξ^- HYPERON
Janice Button-Shafer and Deane W. Merrill 11 Jan. 1965 45 p refs
(Contract W-7405-ENG-48)
(UCRL-11884) CFSTI: $2.00

Results on the spin and decay parameters of the Ξ^- hyperon are presented. These were obtained from the analysis of events of the type $K^- + p \rightarrow K^+ + \Xi^-$ produced with K^- beams of momentum 1.2 to 2.7 BeV/c incident on the 72-inch bubble chamber. Two methods of treating the data are presented, one involving the projection of coefficients in decay distributions and the other involving maximum-likelihood analysis of these distributions. The projection or moment method yields the better estimate of Ξ^- spin, with a result favoring spin 1/2 and excluding spin 3/2 to approximately 2.5 standard deviations. The maximum-likelihood method gives good estimates of decay parameters, with α_Ξ (the usual asymmetry parameter) = -0.30 ± 0.08 and with the ratio $\beta_\Xi/\gamma_\Xi = 0.07 \pm 0.19$. The formalism of Byers and Fenster is utilized. Author

N65-22926# Stanford Univ., Calif. High-Energy Physics Lab.
A DETERMINATION OF RADIATIVE TRANSITIONS WIDTHS OF EXCITED STATES IN C^{12}
H. L. Crannell and T. A. Griffy Jul. 1964 15 p refs
(Contract Nonr-225(67))
(HEPL-335; AD-606401)

New absolute values for the elastic and inelastic electron scattering cross sections from C^{12} are presented for a range of q^2 from 0.75 F^{-2} to 3.14 F^{-2}. A new method of analysis was employed to obtain the radiative widths for the first three excited states in C^{12} from the measured inelastic cross sections. This method of analysis does not depend on a model for the transition charge distribution and is useful in determining the multipolarity of the transition. Author

N65-22932# Stanford Univ., Calif. High-Energy Physics Lab.
LINEAR ELECTRON ACCELERATOR PROJECT Status Report, 1 Aug.–31 Oct. 1964
P. Wilson et al Nov. 1964 23 p refs
(Contract Nonr-225(67))
(HEPL-353; AD-609587)

Continued research under the Mark II and Mark III linear electron accelerator project is presented. Inelastic electron scattering and electrodisintegrator studies are being continued under the Mark II program. New leakproof loads were designed to replace the rf loads in the Mark III accelerator. The Mark III electron scattering program installed auxiliary magnets thus allowing the 72-in. spectrometer to measure electrons scattered at 180°. Elastic scattering from the magnetic octupole moment of beryllium 9 and boron 11 was studied as a function of momentum transfer. Difficulties from beam loss or beam cross-section increase caused by beam–beam interactions is reported in respect to colliding beam experiments. Photodisintegration of the deuteron using polarized gamma rays revealed an interesting reversal in sign of the asymmetry at a gamma energy near the meson threshhold. This change in sign is attributed to a change in the basic mechanism for gamma-ray absorption. S.C.W.

N65-22959# Leicester Univ. (England). Dept. of Chemistry
THE EFFECT OF ADDED ELECTROLYTES ON THE F.S.R. AND OPTICAL ABSORPTION OF METAL-AMMONIA SOLUTIONS Scientific Report No. 5
M. C. R. Symons Jun. 1964 18 p refs
(Grant AF-EOAR-62-64)
(AFOSR-64-2429; AD-609557)

A confined model for the solvated electron is developed by analogy with related systems, and is used to describe the spectral properties of electrons trapped in various media. The nature of the diamagnetic species in metal solutions is discussed in view of the proposed model. Author

N65-22961# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
INTERNAL BREMSSTRAHLUNG ACCOMPANYING THE ELECTRON CAPTURE DECAY OF Hg^{197}
A. Jasinski, J. Kownacki, H. Lancman, and J. Ludziejewski Dec. 1964 17 p refs
(Rept.-532/I-A)

The K X-ray coincidence internal bremsstrahlung spectrum was studied with the aid of scintillation spectrometry. The total decay energy was deduced from the endpoint of internal bremsstrahlung and was found to be 1736±40/keV. The experimental results were compared to the theory of Glauber and Martin for the allowed transitions. Author

N65-22983 European Organization for Nuclear Research, Geneva (Switzerland).
A FORTRAN PROGRAMME FOR THE ANALYSIS OF HYPERFRAGMENTS AND FOR OTHER EMULSION STUDIES
A. G. Frodesen (Oslo Univ.), K. S. Kolbig, and M. M. Nikolic 8 Feb. 1965 74 p refs
(CERN-65-6)

Discussed is a program for identifying hyperfragments from kinematical analysis of the production and/or decay vortex adapted for a simplified approach to the identification problem of capture processes on light emulsion nuclei. The first part of the program determines the energy, momentum and momentum components, as well as the errors in these quantities for all identity assignments on the basis of input information. The second part permutes systematically all identity assignments and selects two sets of combination which satisfy the conversion laws for charge and baryon number. The third part treats the energy balance in different ways depending on the momentum unbalance and the event in question. Considered are the following cases: (1) no neutral particle has been emitted in the reaction; (2) a π^0 has been emitted and cancels the resultant momentum of the prongs; and (3) a neutron carries off the momentum unbalance. The program was originally written in Fortran II, later translated into CERN Fortran, and is available in the CERN program library. G.G.

N65-22989# Fiat S.p.A., Turin (Italy). Nuclear Energy Div.
GAMMONE—PROGRAM FOR GAMMA-RAY ATTENUATION THROUGH MULTILAYER COMPOSITE SHIELDS [GAMMONE—PROGRAMMA MONTECARLO PER IL CALCOLO DELL'ATTENUAZIONE DEI RAGGI GAMMA ATTRAVERSO SCHERMI LAMINARI COMPOSITI]
L. Criscuolo and M. G. Cerisola Brussels, EURATOM, Jan. 1965 116 p Work done in conjunction with Comitato Nazl. per l'Energia Nucl. Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 150 Belg. Fr.
(Contract EURATOM-008-61-12 PNII)
(EUR-2204.i)

The GAMMONE program is an IBM-704 code which applies Monte Carlo methods to simulate gamma-ray life histories in a source–shield configuration. The report describes the physical and mathematical bases of such a program. The shield studied is a multilayer composite rectangular parallelepiped. The gamma source has different shapes: point, line, infinite plane, disc. Several techniques, such as importance sampling, are used for increasing the efficiency of a Monte Carlo calculation. The outputs of the code are energy and dose attenuation and buildup through the shield, as well as energy and dose reflection probability at the source–shield interface. A comparison of results obtained from the code shows good agreement with results from other authors. The GAMMONE (GAMMA Monte-Carlo) IBM-704 computer program determines, using sophisticated Monte Carlo techniques, gamma-ray attenuation characteristics in a composite multilayer shield. The report presents the Fortran listing of the main program and of the seven subroutines, a short explanation of the use of such subroutines, some typical outputs, and the detailed description of the input formats. Author

N65-22993# Sandia Corp., Albuquerque, N. Mex.
ON THE $^2\Sigma^+_g$ AND $^2\Sigma^+_u$ STATES OF THE HYDROGEN MOLECULE ION
James M. Peek Apr. 1965 46 p refs
(SC-RR-65-77) CFSTI: $3.00

The eigenparameters for H_2^+ are calculated for the $1s\sigma\ ^2\Sigma^+_g$ and $2p\sigma_u\ ^2\Sigma^+_u$ states of H_2^+ over the range of internuclear separations $R = 0.1(0.01)1.00(0.05)30.0a_o$. The screening parameters and energies for the LCAO (linear combination of atomic orbitals) approximation to these same two states are calculated for $R = 0.05(0.05)20.0a_o$. The dipole matrix element is calculated for $R \leq 9.0a_o$ in the LCAO approximation and also with approximate functions used for these states by Cohen, Judd, and Riddell. The resulting energies and dipole matrix elements calculated with these approximate functions are compared with the calculations based on the H_2^+ eigenfunctions. Author

N65-22996# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H, Seibersdorf (Austria). Physik-Institut
THE MEASURING OF KINETIC ENERGY OF THE FISSURE FRAGMENTS OF THE U^{235} FISSION [MESSUNG DER KINETISCHEN ENERGIE DER SPALTBRUCHSTUCKE VON DER U-235-SPALTUNG]
M. Schneeberger and H. P. Axmann [1964] 8 p In GERMAN Presented at the Fall Conf. of the Austrian Physical Soc., Graz, 1964
(SGAE-PH-10/1964)

A two-dimensional detector system consisting of 2 np silicon semiconductors was used to measure the symmetric energy distribution of fission products from a U^{235} reaction. The detector spectrum was calibrated by a ThC + ThC' alpha source. During a 10-hour period at 5-MW reactor power, 42 000 fissures were registered. A contour diagram correlating the energy of the light and heavy fission products with the total kinetic energy and the mass distribution is presented. Transl. by G.G.

N65-23016# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics
PARAFERMION MODEL FOR HIGHER BARYONIC RESONANCES
Shigeo Hatsukade Feb. 1965 12 p refs
(RIFP-43)

Various properties of the lowest 56-plet of baryons, including spin, parity, mass, and magnetic moment, were shown to follow from SU(6) symmetry. To explain this symmetry, Greenberg proposed that quarks (or aces) are parafermions of an order 3, and that the baryon 56-plet is a completely symmetric system composed of three such parafermions in an s-state. This model is applied to the higher baryonic resonances, and it is shown that the model can succeed only if one assumes that the orbital angular momentum is shared equally by the three parafermions. Author

N65-23022# Rochester Univ., N. Y. Dept. of Physics and Astronomy
OBSERVATION OF THE LOW ENERGY λ-p INTERACTION
A. C. Melissynos, N. W. Reay, J. T. Reed, T. Yamanouchi, E. Sacharidis (Brookhaven Natl. Lab.) et al 24 Mar. 1965 12 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-78)

The preliminary results of the measurement of the spectrum of K^+ mesons produced in p-p collisions at 2.85 and 2.40 BeV are reported. The external proton beam of 5×10^{10} protons/pulse was incident on a 12-inch hydrogen target, and three spectrometer channels were established at 0°, 17°, and 32°. Each channel was equipped with focusing quadrupoles and appropriate bending magnets in an arrangement similar to one previously used for the measurement of the pion spectra. The momentum resolution was 1.2% for the 0° beam and 2% for the other angles. The K^+ mesons were identified by momentum analysis and velocity discrimination in differential Cerenkov counters. The K^+ mesons cross sections in p-p collisions and the scatterings length and effective range for the Λ-p system (fermis) are shown. Further, no evidence was found for the Λ-p resonance at Q = 45 MeV nor for a broad resonance at Q = 310 MeV as previously reported by others. E.E.B.

N65-23058# Bettis Atomic Power Lab., Pittsburgh, Pa.
ROC-1—A FORTRAN PROGRAM FOR STORAGE OF EVALUATED NUCLEAR DATA
D. R. Harris, A. V. Vota, G. E. Morris, C. B. Noll, and H. Bohl, Jr. Jan. 1965 53 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-493) CFSTI: $3.00

Descriptions are given of the ROC-1 and MO431 Fortran programs for storage, retrieval, and exchange of evaluated nuclear data used in reactor studies. The ROC-1 program reads sets of evaluated nuclear data from punched cards, and prepares or updates a master nuclear data storage tape which is referred to as the ROC library tape. The MO431 program prints out an edit of part or all of the information on the ROC library tape or punches the data on cards in a format acceptable as input to the ROC-1 program. Alternative storage forms for evaluated nuclear data are described and identified, and certain storage forms are recommended for efficient retrieval and use by reactor study programs. Author

N65-23094# Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France).
DETERMINATION OF NEUTRON FORM FACTORS FROM PION ELECTROPRODUCTION
J. P. Loubaton Mar. 1965 31 p

The isobaric model is applied to the study of pion electroproduction on protons. The interpretation of experimental results gives a small negative value for the electric form factor of the neutron. Then, it is shown how coincidence experiments yield information about $\mu^v = G_M^p - G_M^n$. Author

N65-23100# Ontario Research Foundation, Toronto. Dept. of Physics
A REVIEW OF THE (MACROSCOPIC) LAWS FOR ELECTRON PENETRATION THROUGH MATTER
B. W. Schumacher 30 May 1964 80 p refs

Knowledge of electron penetration through matter, especially as far as it is founded on observation and measurement, is summarized, and the relations by which this process has been described are critically reviewed. Without any reference to the individual collisions of electrons and atoms a number of macroscopic laws are often referred to such as the range–energy relation, the exponential attenuation law, the depth–dose function, etc. The mutual relationship and compatibility of these laws, which has never been completely elucidated, is investigated. A logically consistent description of the phenomena is presented and some final, clarifying measurements are suggested. Author

N65-23106# Atomic Weapons Research Establishment, Aldermaston (England).
THERMAL MECHANISMS AT HIGH ALTITUDE
R. J. Wilson Aug. 1964 14 p
(AWRE-0-59/64)

A broad summary of the thermal mechanisms involved in the development of a nuclear explosion at altitudes greater than 25 km is given. The form of the pulse of thermal radiation at the ground is shown to change gradually from the double peaked form observed for low air bursts to a faster, monotonically decreasing pulse for altitudes of detonation above 80 km. Some numerical estimates of the relative energy radiated by the different mechanisms are given, and some of the uncertainties associated with such calculations are indicated. It is pointed out, however, that the lack of data on the response of targets to thermal pulses of this general nature represents a more serious limitation than uncertainties of prediction in assessing the thermal hazard from a high altitude nuclear explosion. Author

N65-23149# Los Alamos Scientific Lab., N. Mex.
GAMLEG—A FORTRAN CODE TO PRODUCE MULTIGROUP CROSS SECTIONS FOR PHOTON TRANSPORT CALCULATIONS
K. D. Lathrop 23 Apr. 1965 34 p
(Contract W-7405-ENG-36)
(LA-3267) CFSTI: $2.00

The GAMLEG is a cross section code which prepares group averages of the Legendre moments of the Klein–Nishina differential scattering cross section. For the isotropic component the group scattering cross section is prepared and compared to the sum of the partial cross sections to insure consistency. The code also accepts as input; absorption, coherent scattering, source, and flux data (for up to 1000 pieces of information at up to 1000 energy points for each type of input), and provides group averages of this data. At the option of the user, cross sections can be flux-weighted, source weighted, or unweighted. Up to 100 energy groups can be formed from group energy bounds supplied by the user. Group averages are performed by trapezoidal integration at up to 100 intervals in each group. As written, up to six Legendre component scattering matrices may be prepared for an arbitrary number of elements. Additional moments may be prepared with minor code modification. Cross-section output is in a form suitable for input to the DTF and DDF transport codes. Author

N65-23294# Sandia Corp., Albuquerque, N. Mex.
TRANSMISSION OF X RAYS THROUGH AIR
James H. Renken Apr. 1965 42 p refs
(SC-RR-65-141) CFSTI: $3.00

The transport equation describing the transmission of photons through a medium which both scatters and absorbs radiation is considered. After specializing to the case of a point source emitting isotropically into a homogeneous medium, a solution for the photon density as a function of various parameters is obtained by using the polynomial method of Fano and Spencer. Sample numerical results are given. Author

N65-23297# Phillips Petroleum Co., Idaho Falls, Idaho.
TERNARY FISSION OF ^{235}U INDUCED BY NEUTRONS OF ENERGY BELOW 1 eV
L. G. Miller and M. S. Moore Mar. 1965 13 p refs
(Contract AT(10-1)-205)
(IDO-17073) CFSTI: $1.00

The neutron energy dependence of the relative ternary-to-binary fission yield for ^{235}U was measured for neutron energies between 0.025 and 1 eV. The data show that the variation in the relative ternary fission yield is less than 1.6% in this energy region. Author

N65-23305# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica
A PROPOSAL FOR AN EXPERIMENT $\gamma+p\rightarrow p+\pi^+ +\pi^-$ TO BE CARRIED OUT BY MEANS OF A DIFFUSION CHAMBER AT THE FRASCATI ELECTRON SYNCHROTRON [PROGETTO PER UN'ESPERIENZA $\gamma+p\rightarrow p+\pi^+ +\pi^-$ DA EFFETTUARSI IN CAMERA A DIFFUSIONE PRESSO L'ELETTROSINCROTRON DI FRASCATI]
G. Cortellessa and P. Salvadori 25 Nov. 1964 24 p refs In ITALIAN; ENGLISH summary
(ISS-64/46)

Theoretical reasons are discussed for a differential cross-section measurement of the $\gamma+p\rightarrow p+\pi^+ +\pi^-$ reaction in the photon energy region between the threshold and 1 GeV. The proposed experimental technique, i.e., pressurized hydrogen filled diffusion chamber in magnetic field, is described. The total number of pictures and the analysis and measurement work necessary for increasing the experimental information is discussed. Author

N65-23313# Stanford Univ., Calif.
NUCLEAR STRUCTURE RESEARCH PROGRAM Final Progress Report, Apr. 1–Dec. 31, 1964
W. E. Meyerhof, 26 Feb. 1965 8 p refs
(Contract Nonr-225(75))
(AD-612038)

Nuclear energy levels and nuclear reaction mechanisms were studied. Proton, deuteron, helium-3 and alpha particle reactions on Li^6, Li^7, and Be^9 were studied. A gamma-ray detector was used which features cosmic-ray anticoincidence shielding and antipile-up circuitry. Cluster effects are described. It was found that the levels in Be^8 between 16 and 18 MeV can apparently be described by simple shell model wave functions. Lifetimes of the first excited states of the mirror nuclei Li^7 and Be^7 were determined by Doppler shift measurements using Li-drifted germanium detectors. TAB

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-22260# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
INVESTIGATION OF GAS IONIZATION PHENOMENON AT OPTICAL AND IR FREQUENCIES Second Interim Technical Report, 11 Aug.–11 Dec. 1964
Vincent Dovydaitis, Jr. Griffiss AFB, N. Y., RADC, Feb. 1965 86 p refs
(Contract AF 30(602)-3332)
(RADC-TR-64-568; AD-612499)

The status of the work on ruby laser induced gas ionization is reported. Experimental measurements of the focused spot diameter, breakdown emission, ionization times, and nonattenuation ionization are presented. The theoretical study results obtained to date in the areas of nonlinear ionization initiation and the extension of the microwave breakdown theory are discussed. Author

N65-22262# Naval Postgraduate School, Monterey, Calif.
BEHAVIOR OF GYROTROPIC PLASMA SEPARATION CONSTANTS AS FUNCTIONS IN THE ω-β PLANE Research Paper No. 47
Vladislav Bevc Feb. 1965 48 p refs
(AD-459550)

The type of the functions appearing in the expression for electromagnetic fields in finite magnetoplasmas depends only on the properties of the medium manifested in the separation constants. The ω-β plane of the Brillouin diagram is partitioned into a definite number of zones characterized by the type of field solutions. The general quantitative behavior of the separation constant for finite magnetoplasma in a longitudinal magnetic field on the Brillouin diagram is described. Author

N65-22264# Advisory Group for Aeronautical Research and Development, Paris (France).
THE APPLICATION OF LANGMUIR PROBE TECHNIQUES TO FLOWING IONIZED GASES
C. L. Brundin and L. Talbot Sep. 1964 55 p refs Presented at the AGARD Specialists' Meeting on Arc Heaters and MHD Accelerators for Aerodyn. Purposes, Rhode-Saint-Genese, Belgium, 21–23 Sep. 1964 Sponsored by AFOSR
(AGARD-478)

A detailed theoretical and experimental investigation regarding the use of stagnation point Langmuir probe techniques in a flowing partially ionized gas has been carried out. The analysis is restricted to the supersonic flow of a weakly ionized gas, and to the determination of ion density from the saturated ion current, and the determination of electron temperature from the rate of change of electron current with probe potential. Numerical results are presented for argon, along with the results of a series of experiments conducted in an arc-heated supersonic low-density wind tunnel. The stagnation point probe measurements are compared with measurements made with free molecular Langmuir probes and with microwave measurements. It is concluded that the ion density can be measured accurately with a stagnation point probe. The measured electron temperature corresponds to the value behind the shock wave, but the relationship to the free-stream value is not known. Author

N65-22270 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
WAVES IN PLASMAS
P. O. Berrett and C. C. Johnson *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 78–95 ref (See N65-22265 12-10)
(Grant NSF GK-29)

Plasma wave propagation in waveguides and microwave structures was studied. A cesium plasma tube in which the plasma was created thermionically, and a mercury arc discharge plasma tube were used in making electronic waveguide measurements of plasma modes. A disc loaded waveguide cavity was clamped on each tube and the effect of the contained plasma was studied by observing the resonances of the cavity. In the cesium plasma tube, because of the quiet and uniform nature of the plasma, the effect of the magnetic field on each cavity mode was observed. Microwave cavity

measurements indicated plasma densities of the order of 10^{17} electrons/meter^3 or $f_c \cong 2.85$ kMc. Accurate measurements of resonant frequency shifts were not obtainable due to low plasma density and unsuccessful attempts to control plasma density by temperature adjustment of the cesium reservoir. In the mercury arc discharge plasma tube, sufficiently high plasma densities (near 10^{18} electrons/meter^3) allowed measurement of the shifts in resonance frequency due to the plasma. The plasma was not uniformly dense along the axis, however, and the effect of the magnetic field on each mode was not separately distinguishable. S.C.W.

N65-22271 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.

PLASMA GENERATION AND MEASUREMENTS

C. H. Ma and C. C. Johnson *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 96–105 refs (See N65-22265 12-10)

(Grant NSF GK-29)

To gain a better understanding of plasma behavior, a series of electron density and temperature measurements were made on a mercury arc discharge plasma in the presence of an axial magnetic field. Reference is made to previous experiments concerning plasma density variation along the axis of the 1-cm diameter mercury discharge tube. When the plasma column is in the nonuniform axial magnetic field generated by a coil, the plasma density has a maximum value at the point where the axial magnetic field starts from zero. Short cavity measurement data were obtained for the mercury discharge at a mercury vapor pressure of 300° K with the plasma half in a statical magnetic field of 1600 Gauss and the other half at B = 0. A theory for ambipolar diffusion in a nonuniform magnetic field was developed, and an IBM 7040 Fortran program was written to solve numerically the resultant differential equation. The theory was found to be in fair agreement with the experiment, although many simplifying assumptions were made. S.C.W.

N65-22272 Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.

PLASMA FOR A COUPLING MEDIUM

V. A. Gilson and C. C. Johnson *In its* Microwave Device and Phys. Electron. Lab. Consolidated Quart. Rept. 31 Dec. 1964 p 105–122 (See N65-22265 12-10)

(Grant NSF GK-29)

An investigation on the use of a plasma in coupling a circuit's electromagnetic fields to an electron beam is reported. The effects of an axial dc magnetic field and plasma density on beam coupling incidence were studied using dispersion and electron beam coupling impedance equations derived for a disc loaded waveguide containing a uniform plasma column in the presence of an axial dc magnetic field. A cesium contact ionization tube for generating thermally ionized plasma was also investigated. Attempts to generate thermally ionized plasma were unsuccessful because of problems inherent in the heat shield, which resulted in unnecessary removal of charged particles. S.C.W.

N65-22329# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.

THE STABILITY OF THE POISEUILLE PLASMA ARC IN AN AXIAL MAGNETIC FIELD

Man-Chuen Yuen Nov. 1964 139 p refs

(Grant NSF GP-414)

(TR-11)

The nature of the instability of the positive column of the Poiseuille plasma arc in an uniform axial magnetic field was studied. The arc was disturbed to get the magnitude of the axial magnetic field at neutral stability, and the decay or amplification of the disturbance as it moved downstream was observed by photomultipliers of adequate sensitivity and time response. The neutral stability was defined as the condition in which the disturbance remained stable. The arc current ranged from 60 to 140 A and the flow rate from 0.04 g/sec to 0.12 g/sec. It was found that the critical axial magnetic field of the naturally excited oscillation is higher than the minimum critical magnetic field of the neutral stability for the same arc current and flow rate. Wavelength measurements show that the phase velocity is dispersive. A linearized stability theory was developed from the discontinuous model. It was concluded that thermal stabilization alone is not enough to stabilize the arc, and that viscous damping plays an important role. G.G.

N65-22396# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrophysics

MODAL ANALYSIS AND SYNTHESIS OF ELECTROMAGNETIC FIELDS

L. B. Felsen and N. Marcuvitz 4 Nov. 1964 73 p refs

(Contract AF 19(604)-7499)

(PIBMRI-1243-64; AFCRL-65-86; AD-613037)

Modal methods are employed to represent the electromagnetic fields due to confined source distributions in an infinite, homogeneous, gyrotropic dielectric, with special emphasis on the case of a magnetoplasma. It is shown how the plane wave refractive index surfaces for the medium may be employed to impose the radiation condition, to locate stationary points in the integral representation, and to interpret the asymptotic field approximation in ray-optical terms. The field behavior in transition regions is emphasized. The results are then extended to plane stratified media, with the gyrotropic axis parallel to the direction of stratification. The treatment of simple diffraction problems wherein unidirectionally propagating surface waves may play a role is discussed. Author

N65-22581*# National Aeronautics and Space Administration, Washington, D. C.

ON ONE-DIMENSIONAL AUTOMODEL WAVES MOVING IN A PLASMA ALONG A MAGNETIC FIELD [OB ODNOMERNYKH AVTOMODEL'NYKH VOLNAKH RASPROSTRANYAYUSHCHIKHSYA V PLAZME VDOL MAGNITNOGO POLYA]

B. A. Tverskoy May 1962 11 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 42, no. 3, 1962 p 833–838

(NASA-TT-F-8218) CFSTI: HC $1.00/MF $0.50

A one-dimensional steady state pulse moving along a magnetic field in a cold plasma is considered. The calculations are performed in the nonrelativistic single-particle approximation without taking into account the collisions, the plasma being assumed quasi-neutral. An exact solution of the corresponding equation is presented. The shape of the pulse and the distribution of velocity are investigated. The lines of force of the magnetic field and the particles' trajectories in the pulse are found to be spirals. Determined also is the dependence of the Mach number on the wave energy. It is shown that even small oscillations of the magnetic field cause an appreciable acceleration of the electron component of the pulse at its maximum. Most of the wave energy is in this case concentrated in the kinetic energy of electrons. Author

N65-22585*# National Aeronautics and Space Administration, Washington, D. C.

STEADINESS IN THE FLOW OF A WELL-CONDUCTING FLUID ACROSS A MAGNETIC FIELD [OB USTOYCHIVOSTI TECHENIYA KHOROSHO PROVODYASHCHEY ZHIDKOSTI POPEREK MAGNITNOGO POLYA]

B. A. Tverskoy 20 May 1962 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Gidromekhan. (Moscow), v. 143, no. 2, 1962 p 301–304

(NASA-TT-F-8226) CFSTI: HC $1.00/MF $0.50

A dimensionless parameter used in the solution of the problem of steadiness of flow of a conducting fluid across a magnetic field was investigated. The parameter was considered for the condition of M being less than one, of M being greater than one, and for V_0 being less than c. Long waves, where kl is less than one, and wavelengths where κ is greater than one are also examined. In this case the density of the potential (and kinetic) energy of the fluid is much greater than that of the magnetic energy of the exterior field. The obtained unsteadiness limits the categories of flows at which MHD self-excitation of regular magnetic fields is possible; flow cases where the lines of force in specific regions have the shape of strongly elongated parabolas are excluded by these limitations. A consideration of the parameter equations reinforces the theory that turbulent pulsations disrupt the magnetic field correlation, thereby linking it with the minimum turbulence scale and accounting for the correspondingly low energy. It seems probable that this mechanism is not unique and that a similar unsteadiness takes place in other cases at strong line of force deformations. L.S.

N65-22587*# National Aeronautics and Space Administration, Washington, D. C.

SOURCE OF PLASMA FOR HIGH VACUUM

B. P. Kononov and K. A. Sarkasyan Feb. 1962 9 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 31, no. 11, 1961 p 1294-7

(NASA-TT-F-8248) CFSTI: HC $1.00/MF $0.50

A device for obtaining plasma in a vacuum system with a pressure drop by mixing electron and ion beams is described. A system of coils generated a longitudinal magnetic field in the maintained vacuum and the plasma was induced by the feeding of voltage from a capacitor to the electrons. The plasma density was measured with a single high frequency probe. Measurements of the firing voltage both with and without a pressure drop showed that the voltage of the discharge's firing was determined by the conditions in the cathode area and depended little on the presence of a pressure drop. Oscillograms showed a delay in the current's development from the beginning of the discharge to the attainment of its maximum value which is explained by the compensation of the spatial charge of the electron beam and the current increase taking place after the ions reach the cathode tube. The experimentally obtained dependence curves of current delay upon pressure in the area of high vacuum for two voltage values in the discharge-type capacitor are presented. G.G.

N65-22617*# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Electronics Lab.

INVESTIGATION OF ION BEAM DIAGNOSTICS Final Report

J. M. Sellen, Jr. and Robert F. Kemp 15 Apr. 1965 138 p refs (Contract NAS3-4114)

(NASA-CR-54147; STL-4137-6018-SU-000)

Results of a research program designed to investigate ion beam diagnostics are presented. Studies of plasma wind tunnel techniques, experiments on the in-line mercury optical resonance probe, an analysis of flight test data from the SERT-I spacecraft, and sensitivity tests of the flight model E-field meter from the SERT-I spacecraft, are described. S.C.W.

N65-22776# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.

PARTICLE INJECTION TECHNIQUES FOR VELOCITY MEASUREMENT IN ARC PLASMAS

Errol V. Seymour Dec. 1964 62 p refs

(Grant NSF GP-414)

(TR-12)

This report describes the work done on a particle injection technique for measuring velocity profiles in an ionized gas flowing through a tube. The method consists essentially of injecting small particles under known conditions into the plasma and relating the plasma velocity to the observed motion of the particles. The particles may be observed photographically while within the plasma, or be allowed to leave the plasma and their subsequent motion followed. Both methods involve the problem of interpreting the motion of the particles in terms of the plasma velocity. This is complicated by the fact that the plasma temperature is sufficiently high to cause vaporization of the particles before they reach the same speed as the surrounding gas. Exploratory experimental work shows that it is possible to measure the particle motion within the plasma. Observation of the particle motion outside the plasma is considerably easier. The general equations for particle drag and heat transfer from continuum mechanics are described in detail, and the problems associated with applying them to the present problem discussed. The effects of slip flow are shown to be negligibly small. Thermal radiation effects on heat transfer are shown to be less than 4 1/2%. Reasons are presented for not allowing any particle vaporization while measurements are being taken. Author

N65-22812# Philco Corp., Philadelphia, Pa. Applied Research Lab.

REFLECTION AND SCATTERING OF SOUND BY FLAMES Final Technical Report

H. M. Wight 30 Nov. 1964 110 p refs

(Contract AF 49(638)-1106)

(U-2931; AFOSR-65-0432; AD-612057)

The report describes acoustic measurements taken with various laboratory flame systems. These involved (1) determination of the acoustic scattering and attenuating characteristics of an open premixed propane flame, (2) determination of the attenuation of open solid propellant flames containing varying aluminum concentrations, and (3) determination of the acoustic combustion noise emission characteristics of various solid propellants. The acoustic attenuation, measured with a collimated sound beam propagating through various open gas and solid propellant flames, was extremely high. The observed attenuation coefficient was at least two orders of magnitude in excess of that attributable either to classical viscous and thermal conductive losses or to molecular relaxation losses. Acoustic scattering measurements indicated intense lateral scattering to be the probable cause of the high attenuation. An acoustic scattering theory was developed in conjunction with a postulated model for a turbulent flame. The acoustic combustion noise generated by burning small slabs of solid propellant possessed a continuous broadband spectrum of high amplitude. TAB

N65-22815# California Inst. of Tech., Pasadena. Firestone Aeronautical Lab.

THE ELECTRICAL CONDUCTIVITY OF SHOCK-IONIZED ARGON. A REVIEW OF THE EXISTING EXPERIMENTAL RESULTS

T. F. Zien Sep. 1964 15 p refs
(Contract AF 49(638)-1348)
(AFOSR-64-1488; AD-461013)

A review of existing experimental data on the electrical conductivity of shock ionized argon in the weakly ionized region, the region of intermediate ionization, and in the region of high ionization, is presented. S.C.W.

N65-22816# General Applied Science Labs., Inc., Westbury, N. Y.
STEADY STATE DIFFUSION OF CHARGED SPECIES IN A PARTIALLY IONIZED MEDIUM
F. Lane 14 Aug. 1964 43 p refs
(Contract NOw63-0637-c(FBM))
(TR-457; AD-460902)

An analysis is developed for the diffusion of charged species (electrons, positive ions, negative ions) in a nonuniform medium composed chiefly of neutral species and a much smaller number density of charged species. The objective was to determine the effects of the charge-induced electric field upon the diffusion of the charged species due to gradients in their own (and possibly other charged species) number densities. Certain restrictions were imposed in order for the successive steps in the development to have validity. In view of these restrictions, it was assumed that the background or neutral flow is unaffected by the behavior of the charged species. S.C.W.

N65-22835# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering
STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS Annual Summary Report, Oct. 1, 1963–Oct. 1, 1964
H. J. Oskam [1964] 10 p refs
(Contract Nonr-710(37))
(AD-611065)

The studies were started in 1958 with the measurement of the time dependence of the number density of electrons in decaying plasmas and have been extended by studying the properties of ions, metastable atoms, etc. This investigation is directed towards (1) the relation between the values of the mobility of positive ions as obtained from time-of-flight studies and those calculated from ambipolar diffusion coefficients measurements; (2) the study of the mechanism of electron-positive ion and negative ion-positive ion recombination, combined with the measurement of the reaction rates involved; (3) the production processes and properties of homonuclear and heteronuclear polyatomic ions; (4) the study of the origin of light emitted by a decaying plasma; and (5) the study of the properties of metastable excited atoms. The equipment being used for the studies described has been designed and constructed with the goal of measuring simultaneously the properties of as many plasma constituents as possible. TAB

N65-22851# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
MULTIPHOTON BREAKDOWN TRIGGER
R. G. Tomlinson 18 Mar. 1965 14 p refs
(Contract AF 33(615)-2287)
(Rept.-1935-3; AD-461481)

The conditions under which multiphoton ionization could trigger the breakdown of the noble gases subjected to ruby laser radiation are derived. The relative ionization rates in these gases are dependent on pressure and focal volume, as well as photon flux. The specific prediction is made that for sufficiently low pressure, small focused spot size, and small focal volume the relative ease of initiating breakdown in argon and neon should be reversed. Author

N65-22898# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
DEDUCTION OF A KINETIC EQUATION FOR STABLE OR SLIGHTLY UNSTABLE PLASMAS, PART I [DEDUCTION D'UNE EQUATION CINETIQUE POUR DES PLASMAS STABLES OU FAIBLEMENT INSTABLES, PARTIE I]
Simone Lafleur and Charles Lafleur Dec. 1964 13 p refs In FRENCH; ENGLISH summary
(Contract Euratom 007-62-1 FUAF)
(CEA-R-2527; EUR-1832.f) Available from Belg. Am. Bank and Trust Co., N. Y., Account No. 22.186: 25 Belg. Fr.

The kinetic equation for a homogeneous weakly unstable plasma deduced by Balescu using a very cumbersome method can be very simply obtained from Klimontovich formalism. Author

N65-22943# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INDUCTIVE PLASMA HEATING USING A MULTI-TURN COIL
Edward F. Gibbons and David B. Miller Nov. 1964 20 p ref
(R64SD76; AD-609834)

Earlier inductive plasma studies resulted in very low energy efficiency systems. The purpose was to investigate the effects of increased coil inductance and increased coil filling on system efficiency. Although the new coil inductance accounted for only slightly over 50% of the total circuit inductance, over 27% of the stored energy was coupled into the plasma under proper conditions. Capacitance was 10 μfd, voltages of 6, 7 and 8 kV were employed, and argon over the pressure range 80μ to 500μ, was used as the test gas. Author

N65-23065*# Illinois Univ., Urbana. Dept. of Electrical Engineering
FINITE AND INFINITE H-PLANE BIFURCATION OF WAVEGUIDE WITH ANISOTROPIC PLASMA MEDIUM
S. W. Lee, Y. T. Lo, and R. Mittra Mar. 1965 31 p refs *Its* Antenna Lab. Report No. 65-7
(Grant NsG-395)
(NASA-CR-62470; SR-4) CFSTI: HC $2.00/MF $0.50

The problem of H-plane bifurcation in a parallel-plate waveguide filled with homogeneous, anisotropic, temperate plasma is considered. The static magnetic field is assumed to be along the edge of the septum. By using the Wiener–Hopf technique, the complete field solutions are obtained for both semi-infinite and finite bifurcations. Author

N65-23078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETOHYDRODYNAMIC PHENOMENA IN A LAYER OF CONDUCTIVE LIQUID BETWEEN ROTOR AND STATOR OF AN ASYNCHRONOUS MOTOR
G. S. Tamoyan 9 Mar. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 3, 1964 p 370–377
(FTD-TT-65-173/1+2; AD-612419)

Described are results of theoretical investigation, of the behavior of a layer of conductive liquid, in a gap of an asynchronous motor of infinite length at laminary flow. Presented are formulas for the calculation of slips of elementary liquid layers, in the gap and electromagnetic power losses in the layer. Graphs are given for the velocity profile in the gap, at various Hartman numbers and rotor slippages. Author

N65-23165*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HYDROMAGNETIC STABILITY
S. P. Talwar Washington, NASA, May 1965 14 p refs
(NASA-TN-D-2791) CFSTI: HC $1.00/MF $0.50

Hydromagnetic instability is reviewed with emphasis on physical understanding rather than mathematical rigor. Gravitational instability is discussed, and the effects of finite Larmor radius, finite Larmor frequency, and resistivity are reviewed. Only macroscopic instabilities are dealt with, and no attempt is made to cover all aspects of plasma stability. Author

N65-23211*# General Motors Corp., Indianapolis, Ind. Engineering Dept.
SPECTROSCOPIC INVESTIGATIONS OF PLASMA PROPERTIES Quarterly Summary Report No. 2, 11 Aug.–10 Nov. 1964
R. T. Schneider and F. G. Myers 9 Dec. 1964 36 p refs *Its* Rept.-4038
(Contract NASw-922)
(NASA-CR-62588) CFSTI: HC $2.00/MF $0.50

The performance of the plasma source operated with helium is described. Intensity and temperature profiles of the source are included. A picture of the source taken in the light of different lines is shown. The dependency of the core temperature of the arc on the arc current is shown. The electronic instrumentation for detecting weak spectrum lines is described. Author

N65-23237# Los Alamos Scientific Lab., N. Mex.
FINITE LARMOR ORBIT STABILIZATION
B. R. Suydam 12 Apr. 1965 17 p refs
(Contract W-7405-ENG-36)
(LA-3260-MS) CFSTI: $1.00

The theory of the stabilizing effect of finite ion Larmor radius is applied to a plasma containing several species of ions. The resulting dispersion relation shows that this effect probably stabilizes Scylla and possibly also the plasma focus. Strictly, the theory applies only to a plasma of low β and with gradients ([grad p]/p small); thus the conclusions lack certainty. Author

N65-23245# Harry Diamond Labs., Washington, D. C.
CALCULATIONS OF ELECTRICAL BREAKDOWN IN GASES
A. L. Ward 10 Jan. 1964 21 p refs
(HDL-TR-1193; AD-430336)

A brief review of the basic processes leading to electrical breakdown in gases is given. Formulas are derived for calculating the breakdown voltages of tubes filled with noble or molecular gases. An electronic computer program for calculating complete voltage versus current-density static characteristics is outlined. The calculated lowering of the breakdown voltage with increased ultraviolet irradiation of the cathode illustrates the utility of the time-independent computer program. The actual breakdown transition is calculated using the Townsend model, as modified by space charge, in a dynamic computer program. The agreement of the calculations with published breakdown data is excellent, even for the short breakdown times previously thought explainable only by gas photoionization streamers. Author

N65-23277*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIPOLAR COORDINATES
Russell E. Carr 1 Apr. 1965 22 p refs
(Contract NAS7-100)
(NASA-CR-62613; JPL-TR-32-696) CFSTI: HC $1.00/MF $0.50

A detailed derivation of dipolar coordinates is given, with a demonstration of how to express the commonly used vector formulas in dipolar coordinates. As a part of the demonstration, it is shown how spherical coordinates can be expressed analytically in terms of dipolar coordinates. Since the use of dipolar coordinates leads to a very unwieldy analytical description for the commonly used vector quantities, another approach might be more fruitful in attempting to solve magnetohydrodynamics problems in which a dipole field is assumed. Author

N65-23341# Boeing Scientific Research Labs., Seattle, Wash. **PLASMA PHYSICS LABORATORY Review, Jul.–Dec. 1964**
James E. Drummond Feb. 1965 26 p refs

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Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-22238# Harry Diamond Labs., Washington, D. C.
NUCLEAR MAGNETIC RESONANCE IN BORON TRIOXIDE AT ELEVATED TEMPERATURES
James C. Mc Dade 15 Jan. 1965 58 p refs
(HDL-TR-1259; AD-612384)

The magnetic resonance of the B11 nucleus in vitreous boron trioxide was observed at 10 mcps and at temperatures ranging from room temperature to 800°C. The resonance line narrows with increasing temperature to about 600°C, above which it broadens again. The narrowing below the glass-transition temperature T_g is attributed to lattice vibrations; that above T_g to molecular rotation. The broadening above

600° C is ascribed to the decrease in the lifetime of the energy states. Theory is given relating the line width to the molecular motion of the liquid, there is no evidence for a proposed change in molecular structure. Author

N65-22241# Sperry Microwave Electronics Co., Clearwater, Fla.
DEVELOPMENT OF ADVANCED MICROWAVE COMPONENTS AND TECHNIQUES—PLANAR, HEXAGONAL FERRITES AND DEVICES Final Report
Griffiss AFB, N. Y., RADC, Feb. 1965 116 p refs
(Contract AF 30(602)-2757)
(RADC-TDR-64-432; AD-612930)

Material parameters and methods of preparation of a series of Y-compounds are reported. The high dielectric loss measured in the planar hexagonal ferrites is a limitation on performance of the material in most microwave devices. While an intense program was conducted to minimize dielectric loss, the lowest dielectric loss measured at X-band frequencies on a variety of Y-compositions with differing iron stoichiometry and preparation techniques was 0.01. The inferior characteristics of the planar materials make them less desirable for use in microwave devices than other ferrite materials. Measurements and analyses of the applications of planar hexagonal ferrites in isolators and differential phase shifters are reported. Both theoretical analysis and experimental results strongly indicate that in most microwave devices no improvement in device performance can be obtained by utilizing planar hexagonal ferrites in preference to other ferrite materials. A study of grain orientation in cubic ferrites is also reported. X-ray diffraction studies of nickel ferrite pressed in the presence of a dc magnetic field have shown positive evidence of crystallite orientation. Narrowest X-band linewidth measured on this partially oriented nickel ferrite is 268 Oe. Author

N65-22242# General Electric Co., Utica, N. Y. Light Military Electronics Dept.
FAILURE MECHANISMS AT SURFACES AND INTERFACES Final Report, 1 Jul. 1963–1 Aug. 1964
K. K. Reinhartz, V. A. Russell, D. L. Stockman, W. J. van der Grinten, and W. L. Willis Griffiss AFB, N. Y., RADC, Feb. 1965 112 p refs
(Contract AF 30(602)-3085)
(RADC-TDR-64-454; AD-613036)

A study of the aging and failure characteristics of thin-film field effect triodes was carried out. Techniques for applying stress to the sample devices under controlled conditions were developed and the resulting changes of the characteristics were measured. Samples stored under dry argon at 30° C remained stable after 1 year. An increase of the humidity to 30% caused a decrease of the threshold voltage. During storage at a constant temperature from 50° C to 122° C, the threshold voltage increased reaching a stable value within a few days. During dc electrical stress the threshold voltage either decreased or increased reaching a stable value at constant gate voltage after a few hundred hours. These different failure modes under electrical stress could be correlated with differences in the slow relaxation characteristic of the field effect conductivity which in turn was traced to the treatment of the semiconductor surface during device fabrication. The use of a demountable gate was investigated for the study of interface phenomena. The possibility of using FET as sensors in the study of ionic migration in glass capacitors is also discussed. Author

N65-22245# Motorola, Inc., Phoenix, Ariz.
MICROWAVE ACOUSTIC DELAY LINE AND RELATED ACTIVE DEVICES Final Report
N. G. Sakiotis, W. Brendecke, F. Hickernell, and M. Medina Griffiss AFB, N. Y., RADC, Feb. 1965 262 p refs
(Contract AF 30(602)-3076)
(RADC-TDR-64-503; AD-613562)

Theoretical and experimental investigations of electroacoustic interactions were conducted as a basis for development of active and passive acoustic devices. To demonstrate these phenomena, breadboard models of a 60-Mc/sec electroacoustic amplifier with a 75-dB maximum acoustic gain, a 200-μsec lossless delay line operating at 60-Mc/sec, and a 1-Mc/sec acoustoelectric oscillator, were constructed. Both bonded quartz and integral transducers were investigated. An integral delay line and an amplifier demonstrate the use of compensated-layer CdS transducers. Thermal effects are discussed including methods of heat sinking the crystals for use in continuous wave devices. Combination of Hall and negative-resistance elements were breadboarded for controlling frequency and impedance. Author

N65-22249# Weston Instruments, Inc., Newark, N. J. Solid State Labs.
CHEMICAL FORMATION OF MICROCIRCUIT ELEMENTS Final Report, Jan. 28, 1963–Nov. 30, 1964
T. K. Lakshmanan and J. M. Mitchell Griffiss AFB, N. Y., RADC, Mar. 1965 103 p refs
(Contract AF 30(602)-2971)
(XS-10977-11286; RADC-TR-64-561; AD-613563)

The reactive sputtering technique was applied to form films of titanium and titanium oxide with a wide range of resistivities. Low resistance metallic films and insulating oxide films are found to be suitable for resistor and capacitor microcircuit elements, respectively. Dielectric constants of over 100, and reasonably low dissipation factors have been achieved. Data furnished include frequency dependence of capacitor characteristics, voltage breakdown, long-term stability of resistor and capacitor elements, temperature coefficients and some basic film properties. The feasibility of using titanium–titanium oxide film contact for rectification is demonstrated. High static rectification ratios are obtained. Author

N65-22253# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH PROGRAM ON NEW PEROVSKITE LASER HOST MATERIALS OF THE $A[B'_{0.5}B''_{0.5}]O_3$-TYPE HAVING CUBIC CENTROSYMMETRIC LATTICE SITES Semiannual Report, Aug. 1, 1964–Jan. 31, 1965
F. S. Galasso, G. K. Layden, and D. E. Flinchbaugh Jan. 1965 79 p refs
(Contract Nonr-4606(00); ARPA Order 306; Proj. Defender)
(UACRL-D910269-3; AD-612012)

Research is directed toward obtaining laser host materials with structures having cubic centrosymmetric sites in which trivalent laser activating ions can be substituted. Powders of Perovskite-type compounds having the general formula $BaB^{3+}_{0.5}Ta_{0.5}O_3B^{3+}$ = rare earth Y^{3+}. The Sc^{3+} and In^{3+} ions were prepared and their structures analyzed by means of X-ray diffraction. The studies showed that the most suitable host materials for this program were $BaY_{0.5}Ta_{0.5}O_3$, $BaLu_{0.5}Ta_{0.5}O_3$, $BaSc_{0.5}Ta_{0.5}O_3$, and $BaIn_{0.5}A_{0.5}O_3$ because they had cubic unit cells and contained ions with appropriate electronic configurations. These compounds have been prepared with Cr^{3+} and Nd^{3+} doping, and the fluorescence spectra of the Nd^{3+} doped phases have been recorded and analyzed. Studies involving flux growth of crystals also have been made during this period. TAB

N65-22278 Harry Diamond Labs., Washington, D. C.
SURFACE DEPENDENCE OF MAGNETOSTATIC MODE LINEWIDTHS IN YTTRIUM IRON GARNET
George R. Jones *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 33–40 refs (See N65-22275 12-34)

One phase of a detailed study of the factors that influence ferromagnetic resonance linewidth is reported. The degree and method of surface preparation were found to influence greatly the observed resonance linewidth of spherical specimens of yttrium–iron–garnet. Irregularities in the sample, either on the surface or distributed over the volume, provided a means by which energy was coupled from the ferromagnetic resonance mode to a large number of degenerate short wavelength spin-wave states, after which the magnetic excitation energy in these spinwaves was dissipated by other processes. It was previously found that detailed measurements of the sample surface made possible a quantitative test of the degenerate spinwave theory as applied to surface irregularities. Also, the observed linewidths of the magnetostatic modes did not appear to be related in an orderly manner to the magnetic properties or to the surface irregularities. The close conformity of observations to the theoretical indicated that the semiclassical degenerate spinwave model adequately accounted for the seemingly erratic behavior of the linewidths. E.E.B.

N65-22290 Army Electronics Labs., Fort Monmouth, N. J.
A NOVEL PROCESS FOR ULTRA-FINE CRYSTALLITES, AND THEIR THEORY AND APPLICATION IN MAGNETIC FERRITES
W. W. Malinofsky, R. W. Babbitt, and G. C. Sands *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 197–210 refs (See N65-22275 12-34)

A process is described for the production of magnetic ferrites in previously unobtainable combinations of ultrafine crystalline size (0.1 micron) and high density (98% of theoretical). Through the use of these crystallites it was shown that domain rotation is the predominant magnetization mechanism in conventional Ni-ferrites and NiCo-ferrites, while domain wall motion is the predominant mechanism in NiZn-ferrite. Further, greater threshold fields were found for the nonlinear instabilities at high microwave powers. At X-band these corresponded to a factor of at least 40 in increased power level compared to conventional ferrites. Losses were somewhat high but continued study of the loss mechanism at low biasing fields may improve these. Eliminating domain walls reduced the temperature coefficient of the permeability by an order of magnitude. Further, in a pot-core geometry a miniaturization capability of a factor of three over powdered iron was obtained. E.E.B.

N65-22293 Harry Diamond Labs., Washington, D. C.
RELAXATION PROCESSES IN FERROMAGNETIC INSULATORS
Joseph Nemarich *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 233–245 refs (See N65-22275 12-34)

The magnetostatic mode linewidths were measured at 300° and 4.2° K in a highly polished sample of single crystal yttrium–iron–garnet at X-band frequencies with the static magnetic field along the (111) direction. It was considered that such measurements might indicate the strength of the coupling of degenerate spin waves as a function of temperature. The results obtained were entirely consistent with the previous results obtained by the modulation experiments on the uniform precession mode. It was concluded that efforts directed toward improvements of polishing techniques for spheres or towards reduction of microcrystalline volume imperfections in yttrium–iron–garnet will probably not result in any substantial reduction of the uniform precession linewidth in this material at X-band frequencies and at room temperatures, since the results of this experiment showed that surface and volume imperfections do not play an important role in the determination of the uniform precession linewidth. Further, an examination of the relative linewidths of the magnetostatic modes allows one to infer the degree to which degenerate spin wave coupling is contributing to the total linewidth of any mode. E.E.B.

N65-22314 Army Electronics Lab., Fort Monmouth, N. J.
MEASUREMENTS OF TRUE DARK CONDUCTIVITIES IN FERROCENE CRYSTALS
Edward Zehler and Claire Loscoe Burke *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 507–517 refs (See N65-22275 12-34)

Systematic dark conductivity measurements made on ferrocene crystals are reported. This material was chosen because of its low room temperature resistivity of the order of 10^{13} ohm cm and its simple structure. The resistivity was found to follow an exponential dependence on temperature. The spread of resistivity was large extending over three orders of magnitude at room temperature. The thermoelectric power was measured on crystals about 0.5 cm^2 and about 0.4 mm thick, grown by either sublimation or from benzene solution. As a result of experiments which included voltage probing along the crystal, long time observations, and resistivity measurements, it was concluded that contact and surface effects, and dielectric relaxation effects had a neglible effect on the conductivity of ferrocene crystals providing sufficient time is allowed for the measurements. A true dark conductivity was found to exist in ferrocene which varied from sample to sample and from 10^{-12} to 10^{-14} ohm^{-1} cm^{-1} with no apparent dependence on impurities or crystal direction. E.E.B.

N65-22337# Brown Univ., Providence, R. I. Barus Physics Lab.
STUDY OF SURFACE PROPERTIES OF ATOMICALLY-CLEAN METALS AND SEMICONDUCTORS. EXAMINATION OF (0001) SURFACES OF CdS BY MEANS OF LOW-ENERGY ELECTRON DIFFRACTION Semiannual Progress Report, 1 Jun.–31 Dec. 1963
H. E. Farnsworth and B. D. Campbell [1964] 18 p refs
(Contract DA-36-039-SC-89069)
(PR-4; AD-429412)

Heating the CdS crystal in oxygen (3×10^{-5} torr-min) at 200° C induces adsorption on the (0001) specular surface. The (0001) matte surface of a high purity CdS crystal was examined. The results for this crystal showed the presence of (1104) surface planes in agreement with the results for the same face of another CdS crystal whose purity was unknown. The (0001) matte surface of a high purity CdS crystal was prepared for examination without chemical etch and without exposure to temperatures higher than 400° C. A weak diffraction pattern characteristic of diffraction from a (0001) plane and containing half integral as well as integral order beams in two major azimuths was obtained in agreement with the results for the (0001) specular surface. These results show that the chemical etch exposes the (1104) planes on the (0001) matte surface. Heating the crystal near 500° C in a vacuum caused the appearance of (1104) planes as in the case of the chemical etch. Thus the (0001) plane on the matte surface is unstable under the conditions of chemical etch or heat treatment near 500° C in a vacuum. Author

N65-22340# Little (Arthur D.) Inc., Cambridge, Mass.
FAR INFRARED SPECTRA OF SELECTED CRYSTALS Final Report, 1 Jun. 1961–31 Jan. 1965

James R. Aronson and Hugh G. Mc Linden [1965] 84 p refs *Its* Rept.-63866
(Contract AF 19(604)-8504)
(AFCRL-65-90; AD-613535)

The report is concerned with the techniques and results of an experimental study of the far infrared spectra of selected crystals at room temperature and in the neighborhood of liquid helium temperature. The spectral range in question was between 35 and 690/cm (285 and 14.5 microns) and both reflection and transmission data were obtained. The crystals examined included germanium, silicon, quartz, sapphire, calcium fluoride, strontium fluoride, barium fluoride, sodium chloride, sodium fluoride, lithium fluoride, cesium iodide, cesium bromide, and magnesium oxide. The data were obtained using a modified Perkin–Elmer 201-C far infrared spectrometer and a Hofman research dewar. The reflection data were obtained at 45° incidence. The polarization of the spectrometer was measured and a Kramers–Kronig analysis of some of the data was carried out. Author

N65-22406# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERRELATION OF ORDERING AND MAGNETIZATION PHENOMENA OF FERROMAGNETIC ALLOYS WITH HEXAGONAL DENSELY-PACKED LATTICE
D. R. Rizdv'yanets'kiy 5 Mar. 1965 14 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 3, 1964 p 309–317
(FTD-TT-65-133/1+2; AD-612424)

The ordering of ferromagnetic alloys of type AB and AB_3 with a hexagonal close-packed lattice was studied. It was found that in these alloys, as in alloys with a cubic lattice of beta-brass and Cu_3Au types a mutual effect was noted of the processes of ordering of atoms and magnetization of alloys. Formulae are obtained for the temperatures of the phase transformations of the second kind and their dependence on the alloy composition, the degree of ordering of the atoms and the degree of spontaneous magnetization is established. In the case of transitions of the first kind the temperatures of the transitions will be somewhat higher than those determined by the formulae obtained. Author

N65-22415# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
STUDY OF FERRIMAGNETIC CRYSTALS BY PARALLEL PUMPING
James C. Sethares and Frank A. Olson Jan. 1965 129 p refs *Its* Spec. Rept. No. 19
(AFCRL-65-64; AD-613321)

A study of single-crystal ferrimagnetic crystals at microwave frequencies was conducted. The parallel-pumping technique was used to experimentally measure spin-wave linewidth, magnetoelastic coupling constants, energy exchange constants, and phonon linewidths. The experiments were carried out at 30° K, 194° K, 77° K, and 4.2° K at X- and K-band frequencies. Four samples of pure, single-crystal yttrium iron garnet (one disk, and three spheres) were extensively investigated. Conditions for optimum detection sensitivity of spin-wave instability measurement are given and discussed. The theory of parallel pumping is explained and worked out in detail. Expressions are obtained for spin-wave and phonon linewidths, magnetoelastic constants and exchange constants in terms of experimentally measured quantities. A literature search was made for publications dealing with parallel-pumping phenomena. These articles (over 75) are abstracted for their contents relative to this investigation. Author

N65-22429# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN OPTICAL AND ELECTRICAL PROPERTIES OF THIN INDIUM ANTIMONIDE LAYERS
V. A. Kas'yan and M. V. Kot 29 Jan. 1965 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 5, 1963 p 14–20
(FTD-TT-64-850/1+2; AD-611523)

This report describes a method of obtaining indium antimonide layers of N-type with a mobility of electrons of up to 8500 sq cm/V sec. Given are results of measuring the temperature dependence of electroconductivity, Hall constant and magneto resistances in the temperature range of from 140° to 550° K, and also light permeability in the range of wave lengths of 0.7 to 8.1 microns. It is shown, that the obtained layers can be used for the manufacture of Hall's emf sensing elements. Author

N65-22488# Stanford Research Inst., Menlo Park, Calif.
INVESTIGATION OF THE INTERACTION BETWEEN STRESS WAVES AND TRANSIENT SOLID STATE PHENOMENA Final Report
R. K. Linde, A. J. Hunt, and D. G. Doran 15 Feb. 1965 33 p refs
(Contract AF 49(638)-1296; ARPA Order 500)
(AD-456986)

Both transient and residual effects of shock waves upon solid-state phenomena in various materials were studied. In single crystals of NaCl and KBr with varied initial conditions, no light emission was detected during the initial pass of shock waves up to 36 kbar, even for crystals which had been colored by Co^{60}-γ radiation. This indicates that any induced luminescence must have involved total emitted energies of less than the order of 1 erg/cm^3. For granulated NaCl and KBr pressed to near crystal density, light emission of the order of 10^3 ergs/cm^3 was observed at 36 and 30 kbar, respectively. This emission intensity was found to be very strongly pressure dependent. Electrical polarization of NaCl during shock passage was studied as a function of shock pressure and crystal orientation. Results do not fit into the framework of any existing theoretical models. The bleaching of F-centers in NaCl crystals by shock compression was observed, as was the growth of more complex trapped-electron centers upon exposure of shocked crystals to white light. Samples of Yule marble were shocked and sent for thermoluminescence measurements. Author

N65-22507# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
STANDARD BACK REFLECTION LAUE PATTERNS FOR FACE CENTERED CUBIC CRYSTALS
Stanislaw Szarras Oct. 1964 13 p refs
(Rept.-554/II)

The positions of diffraction spots on the back reflection Laue photographs for the three important crystallographic directions—[001], [111], and [110]—of face centered cubic crystals are calculated. The standard X-ray patterns for these three directions are plotted. Author

N65-22634# Emmanuel Coll., Boston, Mass. Research Language Center
AN INFRARED STUDY OF SOLID SOLUTIONS OF GERMANIUM OF COBALT-FERRITE OF COBALT; AND AN INFRARED STUDY OF SEVERAL COMPOUNDS OF THE TYPE K_2SO_4 AND $BaSO_4$ [ETUDE PAR SPECTROSCOPIE INFRAROUGE DES SOLUTIONS SOLIDES GERMANATE DE COBALT-FERRITE DE COBALT; ET ETUDE INFRA-ROUGE DE QUELQUES COMPOSES DU TYPE K_2SO_4 ET $BaSO_4$]

J. Preudhomme, P. Tarte, and G. Nizet Bedford, Mass., AFCRL, May 1964 34 p refs Transl. into ENGLISH from Spectrochim. Acta, v. 20, 1964 p 275–283, 503–513
(Contract AF 19(628)-3869)
(E-T-FC-64-3; AD-456862)

By the infrared study of solid solutions of $GeCo_2O_4$–$CoFe_2O_4$ spinels, the same results have been found as obtained from magnetic measurements by Durif–Varambon viz, in the case of iron, the preferential occupation of tetrahedral sites; that germanium at low percentages occupies octahedral sites, and passes over to tetrahedral sites only when it exceeds 20%. The concept of independent vibrations may be applied to the high frequency vibrations of $CoFe_2O_4$, but is not applicable to low frequency vibrations. Author

N65-22671# Pennsylvania Univ., Philadelphia. Dept. of Physics
[MAGNETIZATION, PHASE TRANSITION AND INTERACTION PHENOMENA IN FERROMAGNETIC CRYSTALS] Annual Summary Report
Herbert Callen Oct. 1964 9 p refs
(Contract Nonr-551(36))
(AD-611064)

In summarizing the year's work, listings are given of: (1) publications that have appeared during the year; (2) publications in the press; (3) technical reports distributed; and (4) personnel. Summaries are included of the following works in progress: statistical mechanics of the Heisenberg antiferromagnet; magnetostriction and magnetoelastic coupling; properties of the ferromagnetic phase transition; theory of excitons in molecular crystals; and impurity levels in ferromagnets. TAB

N65-22676# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics
HIGH PRESSURE CONTRACT Progress Report
Aug. 1964 22 p
(Contract Nonr-1866(10))
(PR-32; AD-611147)

Analysis of optical transmission measurements of a 1.3μ thick, epitaxial single crystal film of PbS on an NaCl substrate at pressures up to 10 kb using helium as the pressure transmitter indicates that the film is being stressed differently on increasing and decreasing the pressure, and plastic flow of the substrate is inferred. Reflectivity measurements under pressure on CdTe and on HgSe and HgTe failed to yield definitive information on the band structure of the latter two compounds, so measurements of thermoelectric power vs. pressure are being made as an alternate approach. Measurements of a 4.1-eV reflectivity peak in InSb and of the ultraviolet and visible reflectivity spectra of the noble metals under pressure are being made. Reflection measurements on V_2O_3 were extended to higher vacuum ultraviolet energies and were also made with polarized light. Construction of a new ratio-type spectrometer for measuring small increments in absorption coefficients continues. The semiconducting properties of very pure forsterite are being determined. In investigating Faraday rotation in semiconductors, problems of excess rotation at short wavelengths and attempts to use Irtan II windows are reported. Investigations of optical properties of semiconductor thin films of germanium, lead sulfide, and cadmium telluride, mercury telluride, and their alloys are discussed. Studies of the variation in pressure dependence of the optical absorption edge in gallium antimonide of different doping indicate a trend to smaller pressure coefficients as doping is increased. M.P.G.

N65-22758 Army Electronics Labs., Fort Monmouth, N. J.
SUPERCONDUCTORS IN ADVANCED ELECTRONICS
Gerhart K. Gaule, James T. Breslin, Raymond L. Ross, and Roy S. Logan *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 363–374 refs (See N65-22732 12-34)

The low-power as well as the high-power applications of superconductivity are increasing. Both are expected to benefit from the high current relay switch. In contrast to previous switching devices, the new switch has a true open position, and is thus loss free in either position. A novel method for the storage of electrical energy is given by connecting the new switch with a high-current, high-inductance superconducting solenoid. The basic circuits are derived from analogous capacitor circuits. The inductive energy storage is superior to the capacitive one in the operation of pulse light sources. A sharp distinction should be made between the cooling methods suitable for the laboratory and those for technical applications. For the latter, greater use should be made of the now available closed-cycle refrigerators. Higher operating temperatures for superconducting circuits are sought through improved materials. The development of special low loss dielectric materials for these circuits is also suggested. Author

N65-22773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
THE EFFECT OF CHEMICAL COMBINATION ON K X-RAY EMISSION SPECTRA FROM MAGNESIUM, ALUMINUM AND SILICON Technical Report, Oct. 1963–Oct. 1964
William L. Baun and David W. Fischer Dec. 1964 36 p refs
(AFML-TR-64-350; AD-611102)

Wavelength and intensities are reported for the K series of Mg, Al and Si using primary excitation. Included in the tabulation for Mg are the diagram lines $\alpha_1\alpha_2$ and β and the non-diagram lines α', α_3, α_4, α_5 and α_6. Data are given for the Al K and Si K spectral lines $\alpha_1\alpha_2$, β, α', α_3, α_4, α_5, α_6, β'' and β'''. Spectra are shown and line positions and intensities are detailed using both metal and oxide as the X-ray source. Significant differences are seen between metal and oxide spectra especially in wavelength and shape of $K\beta$, and large changes are noted in the intensities of some satellite lines. Spectra from a number of aluminum intermetallic compounds are discussed including line positions, satellite line ratios, and line shape. Author

N65-22825# California Univ., Berkeley. Dept. of Physics
NUCLEAR QUADRUPOLE RESONANCE AND THE ELECTRONIC STRUCTURE OF GALLIUM
Sheldon Russell Kiser (Ph.D. Thesis) Jan. 1965 94 p refs
(Contracts Nonr-3656(05); Nonr-222(94))
(TR-7; AD-612298)

An investigation of the nuclear quadrupolar coupling in solid gallium metal is carried out with the aid of experiments on a single metallic crystal. Two physically inequivalent sites for the electric field gradient tensor are found and the orientation of each set of principle axes is determined. A previous measurement of the asymmetry parameter of the electric gradient tensor is described and an improved value, 0.175 ± 0.010 is reported. The asymmetry parameter may be obtained from the measurement of the splitting of the inner and outer pairs of the Zeeman spectrum when the magnetic field lies in the principle XY plane. The error in the measurements arising from a neglect of the azimuthal dependence of the splitting in the XY plane is given. A theory of the origin of the field gradient tensor based upon P-type bonding of a gallium atom with its first seven nearest neighbors predicts the quadrupolar coupling constant within 5% of the experimental value. The results suggest that the electronic structure may be described in the tight binding approximation. Author

N65-22826# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station

X-RAY DIFFRACTION STUDIES OF THERMAL MOTIONS IN CRYSTALS Quarterly Progress Report, 1 Jun.–31 Aug. 1964

R. A. Young et al 6 Oct. 1964 14 p refs

(Contracts Nonr-991(00); Nonr-991(06))

(QPR-21; AD-610879)

The quarterly progress report contains an abstract for a paper on *Lattice Vibrations in AgCl and the Temperature Dependences of X-ray Bragg Intensities*, by R. M. Nicklow and R. A. Young, to be presented at the Pittsburgh Diffraction Conference, November 1964. Also included is a foreword to the forthcoming technical report No. 3 that is essentially the Ph.D. thesis of Dr. R. M. Nicklow, *Temperature Dependence of Bragg Intensity for Perfect Crystals in Bragg Geometry*. Experiments are under way for measuring the integrated intensity as a function of temperature (100° to 400° K) and of the absolute value for "G" with crystals as free as possible of all defects and strains, where "G" is a zero parameter of an ideally perfect, nonabsorbing crystal according to Parthasarathy (ACTA Cryst. 13:802-806 (1960)). TAB

N65-22891# Northwestern Univ., Evanston, Ill.

ELECTRICAL AND OPTICAL PROPERTIES OF GRAY TIN Final Report, Sep. 1954–Nov. 1964

A. W. Ewald Feb. 1965 10 p refs

(Contracts Nonr-1228(06); Nonr-1228(29))

(AD-612046)

Measurements of conductivity, magnetoresistance, Hall effect, and thermoelectric power were made in the temperature range from 77° to 273° K on thin, slightly polycrystalline filaments of gray tin and indicated a small but finite band gap. Quantitative agreement between these measurements and simple semiconductor models was not found. Growing of single crystals of gray tin by continuous crystallization from a supersaturated mercury solution produced crystals of greater perfection and made the investigation of the dependence of transport properties on crystal orientation possible. Magnetoresistance measurements as a function of crystal orientation together with subsequent measurements of the oscillatory component of the low temperature magnetoresistance on single tin crystals established a 0.08eV-energy separation between the lowest and secondary minima of the conduction band. This new model points out the unique position of gray tin between the typical semiconductors with finite band gaps and the semimetals in which the bands overlap. G.G.

N65-22927# McCrone Research Inst., Chicago, Ill.

DIFFUSION STUDIES IN CERAMIC CRYSTALS Final Report

Leonid V. Azaroff Nov. 1964 8 p refs

(Contract Nonr-3964(01)74)

(AD-609726)

The successful conversion of radioactive Cd layers deposited on hexagonal crystals of CdS or of ZnS is described. The crystals were subsequently annealed and the diffusion parallel and perpendicular to the hexagonal c axis was studied by radioactive tracers and sectioning procedures. Several diffusion runs using CdS and ZnS crystals were completed and the obtained diffusion constants from individual penetration curves of the crystals at given temperatures are presented in tables. It was not possible to establish a definite temperature dependence for the diffusion coefficients. G.G.

N65-22958# Pennsylvania Univ., Philadelphia. Dept. of Physics Physics

A PROBABILITY DENSITY COMMON TO MOLECULAR FIELD AND COLLECTIVE EXCITATION THEORIES OF FERROMAGNETISM

H. B. Callen and S. Shtrikman Nov. 1964 7 p refs

(Contract Nonr-551(36))

(TR-19; AD-609552)

Molecular field theory is frequently used to relate the higher moments $\langle (S^z)^n \rangle$ to the first moment $\langle S^z \rangle$, the latter quantity being known from empirical magnetization data. The results are in excellent agreement with experiment, despite the glaring inadequacies of molecular field theory. It is shown that the functional dependence of $\langle (S^z)^n \rangle$ on $\langle S^z \rangle$ follows only from a particular feature of molecular field theory, which has much wider generality and validity. The same result is obtained in all quasi-independent collective excitation theories. This fact is corroborated in decoupled Green function theories, and is used to simplify the form of these latter theories. Author

N65-22995# Stevens Inst. of Tech., Hoboken, N. J.

TRANSMISSION OF MAGNETIC PULSES THROUGH TYPE II SUPERCONDUCTING PLATES

Hans Meissner [1965] 21 p refs

Penetration of perpendicular magnetic pulses of 1.6-μsec duration through a type II superconducting plate was observed in a perpendicular magnetic field. The plate was a single crystal of Pb with 8% In and had a thickness of 1.65 mm. For large enough pulses, the shape of the transmitted pulse agrees closely with that expected from the diffusion equation $\delta^2 H/\delta z^2 = \mu_0 \sigma \delta H/\delta t$. The time delay of the transmitted pulse as well as its height can be used to find the value of an effective resistivity ζ. For large pulses the data points obtained by the two methods agree with each other and are somewhat below a line given by $\zeta/\zeta_n = (H - H_{c1})/(H_{c2} - H_{c1})$. Near H_{c1} pinning effects are observed. The pulses remain unchanged if ΔH is opposed to the pulsed field. The delay time is not affected by a small change of the superimposed field. Author

N65-23088# Pennsylvania Univ., Philadelphia. Dept. of Physics

MAGNETOSTRICTION, FORCED MAGNETOSTRICTION, AND ANOMALOUS THERMAL EXPANSION IN FERROMAGNETS

Earl Callen (Naval Ordnance Lab., White Oak, Md.) and Herbert B. Callen Jan. 1965 67 p refs

(Contract Nonr-551(36))

(TR-20; AD-612300)

The theory of magnetostriction arising from single-ion crystal field effects for cubic crystals is summarized, extended to arbitrary crystal symmetry, and augmented by inclusion of two-ion interactions. The dependence on magnetic field strength is analyzed, and the totally symmetric component exhibited as an anomalous thermal expansion is discussed. Expressions relating the microscopic magnetostriction coefficients to the product of microscopic magnetoelastic coupling constants and certain spin correlation functions are given. Only three such correlation functions appear; all temperature and field dependence enters through them. They are evaluated by molecular field theory, a cluster theory, and the random phase approximation. Applications to Dy and to EuS are cited, and application to Gd is given. In Gd the sign inversion of a particular magnetostriction coefficient, and its full temperature dependence, are accounted for theoretically. The field dependence of the forced magnetostriction of Gd is discussed, with special reference to the observed persistence of a pseudo-linearity slightly above the Curie temperature. Author

N65-23131# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics
TEMPERATURE DEPENDENCE OF OPTICAL HARMONIC GENERATION IN KH_2PO_4 FERROELECTRICS
Jan P. van der Ziel 7 Apr. 1964 106 p refs
(Contracts Nonr-1866(16); ARPA SD-88)
(TR-431; AD-601393)

Optical second harmonic generation from KH_2PO_4 and KD_2PO_4 platelets were measured as a function of temperature, above and below the ferroelectric transition point, between 77° and 300° K. A phenomenological theory was developed to account for the observed changes in the linear and nonlinear susceptibilities at the transition point. Relations between the tensor elements above and below the ferroelectric transition were obtained. The effects of atomic substitution on the relative values of the second harmonic susceptibilities were investigated by measurements at 300° K on KH_2PO_4, KH_2AsO_4, KD_2PO_4, and $NH_4H_2PO_4$. These substitutions were found to have important effects on the low frequency dielectric and linear optical properties. No substantial changes in the susceptibilities were observed. Measurement of these crystals at 300° K indicate that the ratio of the tensor elements is 0.86 ±0.05. The electro-optic constant r_{63} of KH_2PO_4 was remeasured at 300° K in an optical second harmonic experiment by observing the change in the index mismatch resulting from the application of a dc electric field. The value of r_{63} was $(2.9 \pm 0.5) \times 10^{-7}$ cm per stat volt. Applying a 26-kc per sec ac electric field to the crystal used in the electro-optic experiment resulted in a modulation of the second harmonic intensity. S.C.W.

N65-23135# General Electric Co., Schenectady, N. Y. Research Lab.
SEMICONDUCTOR DEVICE CONCEPTS Scientific Report No. 9 (Final)
H. H. Woodbury, M. Aven, R. N. Hall, R. Baertsch, and F. K. Heumann Nov. 1964 27 p refs
(Contract AF 19(628)-329)
(AFCRL-64-1007; AD-611630)

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3. FM JUNCTION LASER R. N. Hall and R. Baertsch p 15–16 (See N65-23138 12-26)
4. THE PREPARATION OF $GaAs_xP_{1-x}$ ALLOYS FOR LASER APPLICATIONS F. K. Heumann p 17–21 refs (See N65-23139 12-26)

N65-23136 General Electric Co., Schenectady, N.Y. Research Lab.
DIFFUSION OF Se IN CdS AND ZnSe
H. H. Woodbury *In its* Semicond. Device Concepts Nov. 1964 p 1–3 refs (See N65-23135 12-26)

Preliminary investigations of the diffusion of Se in CdS and ZnSe were carried out. Unusual results are obtained for the diffusion of Se in CdS under sulfur pressure. A tentative explanation is the presence of a rapidly diffusing Se specie which has a low solubility. Mixed crystals of ZnSe and ZnTe were synthesized by the vapor phase growth method. The $ZnSe_xTe_{1-x}$ crystals can be made in both n- and p-type conductivity form in the approximate composition range of $0.4 \leq X \leq 0.6$. The crystals are p-type as grown and can be converted to n-type form by doping with Al. Low resistivity n-type crystals exhibit a donor ionization energy of approximately 0.01 eV. Low resistivity p-type crystals show ionization energies between 0.035 and 0.044 eV. The p-n junctions fabricated from the grown crystals show red electroluminescence with a visibility threshold of about 1.4 V at room temperature. The fm junction laser structures were assembled and tested. Studies on the halogen transport synthesis of GaAs and $GaAs_xP_{1-x}$ were continued. A number of GaAs ingots doped with tellurium were made. No correlation between electrical parameters and threshold currents was found. However, material with high threshold currents appears to have a large number of etch pits and cracks. This is also true for the $GaAs_xP_{1-x}$ alloys. It thus appears that strains and imperfections in the crystals affect their laser behavior. Author

N65-23137 General Electric Co., Schenectady, N.Y. Research Lab.
SYNTHESIS AND PROPERTIES OF ZnSe-ZnTe MIXED CRYSTALS IN N- AND P-TYPE FORMS
M. Aven *In its* Semicond. Device Concepts Nov. 1964 p 5–13 refs (See N65-23135 12-26)

Mixed crystals of ZnSe and ZnTe were synthesized by the vapor phase growth method. The $ZnSe_xTe_{1-x}$ crystals can be made in both n- and p-type conductivity form in the approximate composition range of $0.4 \leq X \leq 0.6$. The crystals are p-type as grown and can be converted to n-type form by doping with Al. Low resistivity n-type crystals exhibit a donor ionization energy of approximately 0.01 eV. Low resistivity p-type crystals have shown ionization energies between 0.035 and 0.044 eV. The p-n junctions fabricated from the grown crystals have shown red electroluminescence with a visibility threshold of about 1.4 V at room temperature. Author

N65-23138 General Electric Co., Schenectady, N.Y. Research Lab.
FM JUNCTION LASER
R. N. Hall and R. Baertsch *In its* Semicond. Device Concepts Nov. 1964 p 15–16 (See N65-23135 12-26)

The fm junction laser structures were assembled and tested. Attempts to produce significant amounts of frequency modulation have thus far been unsuccessful due to excessive photocurrents in the modulating section. Author

N65-23139 General Electric Co., Schenectady, N.Y. Research Lab.
THE PREPARATION OF $GaAs_xP_{1-x}$ ALLOYS FOR LASER APPLICATIONS
F. K. Heumann *In its* Semicond. Device Concepts Nov. 1964 p 17–21 ref (See N65-23135 12-26)

Studies were continued on the halogen transport synthesis of GaAs and $GaAs_xP_{1-x}$. A number of GaAs ingots doped with tellurium were made. No correlation between electrical parameters and threshold currents was found. However, material with high threshold currents appears to have a large number of etch pits and cracks. This is also true for the $GaAs_xP_{1-x}$ alloys. It thus appears that strains and imperfections in the crystals effect their laser behavior. Author

N65-23140# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
EFFECTS OF ENERGETIC PHOTON IRRADIATION ON GERMANIUM Physical Sciences Research Papers No. 57
P. H. Hannaway, H. M. DeAngelis, and E. Y. Wang (Tufts Univ.) Oct. 1964 27 p refs
(AFCRL-64-839; AD-608780)

The n-type germanium samples were exposed at ~30° C to gamma rays from a 6100 curie Co^{60} source and X-rays (up to 3 MeV) produced by bombardment of a tungsten target with 3-MeV electrons from a Van de Graaff generator (model KN). From the temperature dependence of carrier concentration for defect levels induced by the X-ray irradiation, evidence was presented for defect levels at $E_c - 0.2$ eV and $E_v + 0.26$ eV. These levels were observed in Co^{60} irradiations. From a study of carrier removal rate as a function of the Fermi level, evidence was also presented for the existence of a very shallow level, E_c to 0.07 eV, induced by Co^{60} gamma rays. Author

N65-23157# Syracuse Univ. Research Inst., N. Y.
A STUDY OF MATERIALS FOR IR DETECTORS
20 Jan. 1964 34 p refs
(Contract AF 33(657)-7590)
(SAR-4; AD-430038)

Progress on transmission studies, electrical properties of impurities, and the preparation of impurity activated In–Ga–Se material is reported. All samples with the exception of one transmit between 35% to 45%. The one sample with 22% maximum transmission was cut from an ingot which was grown early in the investigation and consequently grown at a rate which may make the alloy somewhat inhomogeneous. The homogeneity of the alloy may have an effect on the maximum transmission of the material. Also, the determination of the energy level of impurities from the measurement of the variation of the Hall coefficient with temperature and determining the slope in the freezeout region was discussed, and the apparatus for the measurement of the Hall constant as a function of temperature is described. In all cases, reasonably good agreement between resistivity slopes and Hall slopes were obtained with any discrepancy due to mobility variation with temperature. Since the only impurity studied was the 0.023 GaSb level, whose origin is unknown, any conclusive data as to the possible variation of the impurity level with composition should depend upon results obtained from studies of other impurity levels where origins are known. E.E.B.

N65-23182# Oklahoma Univ., Norman. Graduate Coll.
THE PERSISTATRON UTILIZING A SUPERCONDUCTIVE GROUND PLANE
Charles Edward Schuster (M.S. Thesis) 1965 71 p refs
(Contract AF 33(608)-1096)
(AD-612247)

The persistatron is a thin film superconductive switching device with a most probable application as a memory or computer switching element. The purpose of this work is to (1) construct by means of thin film deposition and photo mask–photo resist techniques persistatrons both with and without superconductive ground planes, (2) compare the switching characteristics by testing those devices in their superconductive state. TAB

N65-23195*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLAR-RADIATION-INDUCED DAMAGE TO OPTICAL PROPERTIES OF ZnO-TYPE PIGMENTS Eight-Month Progress Report, 27 Jun. 1964–27 Feb. 1965
L. A. Mc Kellar 26 Mar. 1965 138 p refs
(Contract NAS8-11266)
(NASA-CR-62520; LMSC-M-50-65-1) CFSTI: HC $4.00/MF $1.00

The identification of the primary mechanisms involved in solar radiation-induced damage to the optical properties of ZnO-type semiconductor pigments, as exemplified by ZnO, is discussed. The following are among the conclusions reported: (1) The initial reflectance spectra of the pressed and sintered particulates were quite similar to those of ZnO pigmented thermal control paints over the wavelength range 0.27 to 2.5 microns. (2) Solar radiation-induced reduction in reflectance of the particulate samples over the same wavelength range was similar to that observed for ZnO paints. (3) Most of the ZnO optical property changes observed appear to be connected with the loss or gain of O_2 by the ZnO. (4) Solar radiation-induced reduction in reflectance spectra of particulate samples is followed by recovery upon exposure to air. (5) Sintering in vacuum appears to produce free zinc at the surface of the particulate samples. (6) Reduction in the reflectance for visible energy is initially generated near the surface, whereas reduction in infrared reflectance appears to be more of a bulk phenomenon. E.E.B.

N65-23196*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Physics
THE THIRD ORDER ELASTIC CONSTANTS OF NaCl AND KCl SINGLE CRYSTALS
Zung-Ping Chang [1964] 46 p refs
(Grant NsG-100)
(NASA-CR-62515) CFSTI: HC $2.00/MF $0.50

Relations between velocities of ultrasonic waves propagating along the $[1\bar{1}0]$ and $[\bar{1}\bar{1}2]$ directions under a uniaxial compression applied in the [111] direction and the elastic constants were derived. Six velocities of these ultrasonic waves were measured at room temperature as functions of the strain using the pulsed ultrasonic interference technique. From the present measurements under the ⟨111⟩ compression and those under the hydrostatic pressure by Lazarus, 11 equations were obtained for both NaCl and KCl crystals, from which these constants (Brugger's definition for the third-order elastic constants) in units of 10^{12} dynes/cm^2 were solved by the method of least squares:

	$C_{111}+2C_{112}$	$C_{111}-C_{123}$	C_{456}
NaCl	−9.91 ±0.04	−9.10 ±0.08	0.271 ±0.014
KCl	−7.44 ±0.01	−7.15 ±0.02	0.118 ±0.004

C_{144}	C_{166}
0.257 ±0.016	−0.611 ±0.007
0.127 ±0.005	−0.245 ±0.002

The Cauchy relation $C_{456} = C_{144}$ is seen to be satisfied to within the probable error in both NaCl and KCl crystals at room temperature. By assuming the validity of the other two Cauchy relations, the constants C_{111}, C_{112} and C_{123} can be estimated as follows:

	C_{111}	C_{112}	C_{123}
NaCl	−8.80	−0.571	0.248
KCl	−7.01	−0.224	0.113

Author

N65-23203# Chicago Univ., Ill. Inst. for the Study of Metals
ELECTRONIC PROPERTIES OF SEMICONDUCTORS AT LIQUID HELIUM TEMPERATURES
H. Fritzsche Feb. 1965 12 p refs
(Grant AF-AFOSR-62-178)
(AFOSR-65-0435; AD-612132)

The research effort was devoted to the three least studied and least understood transport phenomena in semiconductors

at low temperatures which involve the interaction of impurities. These are: (1) impurity conduction, (2) the transition from nonmetallic to the metallic state, and (3) the so-called metallic state of degenerate semiconductors. This work tries to illuminate the detailed physical phenomena which are so important for the increasing number of low temperature solid state devices such as tunnel diodes and junction lasers. TAB

N65-23266# Illinois Univ., Urbana. Dept. of Physics
DYNAMICAL PROPERTIES OF A ONE-DIMENSIONAL "CRYSTAL" WITH FREE ENDS
John R. Clem and Robert P. Godwin [1964] 36 p refs
(Contract AF 49(638)-1048)

Analytical results are provided for the mean square displacement and velocity of the particles of a simple one-dimensional lattice with free ends in the T = 0° K and high temperature limits. The results for the mean square displacement are used to show that the effective Debye temperature (as it would be measured by the Mössbauer effect of diffraction experiments) for a central atom is twice that of an end atom. It is also shown that in this model the effective Debye temperature which would be found in bulk Mössbauer or diffraction measurements is slightly greater than that derived from specific heat measurements. Author

N65-23270# Pennsylvania State Univ., University Park. Materials Research Lab.
THE EFFECT OF PRESSURES TO 10 KBARS ON THE OPTICAL ROTATORY POWER AND ROTATORY DISPERSION OF CRYSTALS
Mark Briner Myers (Ph.D. Thesis) Dec. 1964 76 p refs
(Contract Nonr-656(20))
(TR-20; AD-609184)

The effect of pressure on optical rotatory power and dispersion was investigated on single crystals of α-quartz, sodium chlorate, benzil, and ethylenediamine sulfate in the visible region of the spectrum. Both uniaxial and isostatic pressures were used. The isostatic pressure measurements were made over a range of 4 kbars in an apparatus employing a liquid pressure medium. The uniaxial pressure measurements were made over a range of 10 kbars employing an opposed-anvil apparatus developed specially for this investigation. Major emphasis has been placed on the calibration of the pressures observed in the opposed-anvil apparatus and its adaptation to optical measurements involving the transmission and analysis of polarized light. One of the most important results of the calibration study is the discovery of the importance of the sample diameter-to-thickness ratio in determining the pressures observed in samples used with the opposed-anvil apparatus. Author

N65-23290*# Space Technology Labs., Redondo Beach, Calif.
[IRRADIATION DAMAGE IN N-TYPE SILICON CRYSTALS] Monthly Progress Report, 1 Feb.–1 Mar. 1965
R. G. Downing 24 Mar. 1965 3 p ref
(Contract NAS5-3805)
(NASA-CR-62636; STL-4161-6011-SU-000) CFSTI: HC $1.00/MF $0.50

Specimens of n-type silicon with resistivities of 1 ohm-cm, and 100 ohm-cm, and p-type silicon with resistivities of 150 ohm-cm, 75 ohm-cm, and 15 ohm-cm were irradiated to obtain valid and meaningful information on the defect introduction rates in the range from 1 to 3 MeV. Initial measurements of the irradiated 15- and 75- ohm-cm p-type silicon indicate a steeper energy dependence than that obtained for 150 ohm-cm p-type specimens. Irradiation of additional specimens of all three p-type crystals at 11.5 MeV appears to substantiate the trend to energy dependences similar to the degradation of minority carrier lifetime in p-type silicon. This defect level at eV + 0.29 eV has been referred to as a divacancy. The irradiated n-type specimens exhibited data in good agreement with those previously reported. G.G.

N65-23332*# Naval Ordnance Lab., Corona, Calif. Research Dept.
SURFACE EFFECTS IN ALKALI-HALIDE CRYSTALS RESULTING FROM IRRADIATION BY X-RAYS
J. B. Bernstein, D. D. Kirk, and D. L. Stierwalt Dec. 1964 10 p refs
(NASA Order W-11400-B)
(NASA-CR-62617; TM-43-19) CFSTI: HC $1.00/MF $0.50

This report, shows some results of exposing a series of alkali-halides to X-irradiation and measuring a resulting change in the absorptance spectra of the crystals. The technique employed to examine the crystals is the measurement of their spectral emittance before and after their exposure to X-irradiation. The theory, techniques and experimental apparatus used in acquiring the spectral emittance (spectral absorptance) of a transparent solid, in the infrared region of the spectrum, were previously discussed. The spectral emittance measurement technique represents a direct measure of absorptance. A transmittance measurement would need a supplementary reflectance measurement to determine the spectral absorptance. The crystals measured are KCl (t = 2.10 mm), RbBr (t = 5.31 mm), NaCl (t = 6.56 mm) and KBr (t = 4.65 mm). Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-22229# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
A REPORT GUIDE TO LIQUID PENETRANT LITERATURE
Ernest H. Rodgers and Charles P. Merhib Aug. 1964 58 p refs
(AMRA-MS-64-12; AD-612044)

This guide consists of a bibliography of items currently in the AMRA nondestructive testing information retrieval system covering the subject of liquid penetrants. Where available, each item in this journal consists of the following information: (1) item report, or article title; (2) author or authors; (3) source or facility; (4) report number or identification; (5) date; and (6) abstract. Word descriptors pertinent to each item are listed in alphabetical order and are cross-referenced by the AMRA identification number. Also provided is an author index or, if no author is available, then the issuing organization is listed. TAB

N65-22400* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OIL PRODUCTS AND PRODUCTS OF PROCESSING SOLID FUELS (STATE STANDARDS)
12 Mar. 1965 588 p Transl. into ENGLISH of the publ. "Nefteprodukty i Produkty Pererabotki Tverdykh Topliv" Moscow, Gos. Izd. Standartov, 1963 p.1–527
(FTD-MT-64-235; AD-613449)

Russian state-established standards for production of oil products and products of solid fuels are published. Type of

consumption and specifications for raw materials, chemical composition, physical properties, and some directions for product testing, are listed. Materials discussed are gas fuels, carburetor fuels, diesel fuel, boiler fuel, fuel for motors of various assignments, motor oils, industrial oils, turbine oils, compressor oils, transmission and steering oils, mineral oils of various assignments, consistent lubricants, solvents, paraffin, ceresin, vaseline, wax compositions, petroleum bitumen, products of pyrolysis, petroleum acids and their salts, illuminating oil products, components and additives to fuels, oils, and lubricants. J.M.D.

N65-22457# Dayton Univ., Ohio. Research Inst.
PHYSICAL AND CHEMICAL PROPERTIES OF JP-4 JET FUEL FOR 1963 Technical Report, 1 Feb.–1 Jul. 1964
W. E. Brockman and D. S. Duvall Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., Jan. 1965 96 p
(Contract AF 33(657)-9175)
(AFAPL-TR-64-148; AD-612795)

This report summarizes suppliers' inspection data on 140 million barrels of JP-4 jet fuel furnished to the AF during 1963. Data summarized were reported to AF Aero Propulsion Laboratory, Wright-Patterson Air Force Base, for 8 geographic districts around the world. Of 20 standard specification tests selected for inclusion in this study and reported by geographic district, 19 show a skewed distribution and 1 (Reid vapor pressure) was normally distributed. A possible explanation for the skewed results is the lack of both upper and lower limits in most specification tests. Author

N65-22563*# Martin Co., Denver, Colo.
STUDY OF CONTAMINATION OF LIQUID OXYGEN BY GASEOUS NITROGEN Third Quarterly Progress Report, 1 Jan.–31 Mar. 1965
Dale A. Fester, Philip J. Pizzolato, and John R. Wilde Apr. 1965 52 p refs
(Contract NAS8-11337)
(NASA-CR-62382; CR-64-51) CFSTI: HC $3.00/MF $0.50

The analytical portion of the program has been directed toward completion of the main computer program and its associated subroutines. In addition, special emphasis was placed on developing and improving the basic transport property relationships required. Portions of the computer program are in the checkout–debug phase where this can be accomplished by sections. Other work includes some compiling and the coding of transport property relationships required for two of the subroutines. Construction and checkout of the spherical tank system was accomplished and all of the planned test runs have been completed. Approximately 50% of the data, recorded on strip charts, has been reduced to tabular and/or graphical form. Detailed discussion of progress on both the analytical study and the experimental program is presented. Author

N65-22627# Melpar, Inc., Falls Church, Va.
MECHANISM OF MICROBIOLOGICAL CONTAMINATION OF JET FUEL AND DEVELOPMENT OF TECHNIQUES FOR DETECTION OF MICROBIOLOGICAL CONTAMINATION Quarterly Progress Report, 1 Feb.–1 Jun. 1964
Gordon C. Blanchard and Charles R. Goucher Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., Feb. 1965 132 p refs
(Contract AF 33(657)-9186)
(QPR-4; AD-458430)

The problem of jet fuel contaminants was investigated, including microorganisms, surface-active materials, iron rust, water, and extraneous materials as they pertain to fuel properties, sludge formation, and their degree of participation in the corrosion and degradation of aircraft materials of construction throughout the fuel system. Several major developments were accomplished. The first was the establishment of concepts that explain how various growth media cause the corrosion of aluminum. The second was in understanding the metabolic mechanisms which operate in the production of fuel contaminants such as emulsions and sludges. The third development was in correlating the breakdown of coatings on aluminum with microbial growth. The fourth was the application of several different detector systems to the study of fuel contamination and corrosion. Author

N65-22628# Melpar, Inc., Falls Church, Va.
MECHANISM OF MICROBIOLOGICAL CONTAMINATION OF JET FUEL AND DEVELOPMENT OF TECHNIQUES FOR DETECTION OF MICROBIOLOGICAL CONTAMINATION Quarterly Progress Report, 1 Jun.–1 Sep. 1964
Gordon C. Blanchard and Charles R. Goucher Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., Mar. 1965 48 p refs
(Contract AF 33(657)-9186)
(QPR-5; AD-612792)

This study is concerned with the detection of microorganisms in fuel-water environments and with the mechanisms by which these microorganisms cause problems in fuel systems of aircraft. Fuel isolates removed nitrate from growth medium containing iron and calcium, causing it to become more corrosive to aluminum alloys. Upon prolonged incubation (200 days) fuel isolates produced substances corrosive to aluminum alloys. Microbial sludge, which can cause corrosion, contained N, C, H, and O. Nitrate did not prevent corrosion caused by nitrated phenols; and nitrate does not prevent corrosion caused by media in which fuel isolates have grown for long periods of time. Emulsion-forming organisms contained considerably more lipid material than fuel isolates which were sedimentable in water. Some fuel additives were observed to support the growth of fuel isolates while most anti-icing and metal deactivators were mildly toxic. Respiratory inhibition and ability to kill fuel isolates was demonstrated for pentene, hexene, heptene, octene, and nonene but not for decene or dodecene. The saturated homologs of these compounds were either innocuous or supported growth. Author

N65-22639# IIT Research Inst., Chicago, Ill.
A STUDY OF THE FUNDAMENTALS OF LIQUID PROPELLANT SENSITIVITY Fifth Technical Progress Report, Dec. 1, 1964–Feb. 28, 1965
Ted Erikson Mar. 1965 21 p
(Contract AF 04(611)-9566)
(IITRI-C6024-20; AD-461285)

Explosive sensitivity testing of N–F compounds is continuing. Compound R samples of less than 0.1 g were condensed as gaseous agglomerates on the metal sample cavity, which is held at −180° C. As the incident nitrogen shock wave increases from Mach 2.4 to 3.0, the time delay to ignition from the moment of shock reflection decreases from about 800 to 20 μsec. This measurement is very sensitive at the weaker shocks. Thin films or condensed gaseous agglomerates are one requisite for reproducible results, suggesting that a critical surface-to-volume sample geometry is involved in the ignition by this technique. Author

N65-22774# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ADDITIVES ON THE ANTIWEAR PROPERTIES OF FUELS
G. I. Kichkin, I. V. Rozhkov et al 11 Feb. 1965 15 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 6, 1963 p 60–65
(FTD-TT-64-937/1+2; AD-611531)

Of the investigated jet fuels the best antiwear properties are had by the fuel R-1; the worst by the fuel T-2. With the rise in the temperature within the limits of 20° to 150° C the antiwear properties of the fuel deteriorate considerably. With the addition to the fuel in small concentration (0.01% by weight) of antiwear substances developed for oils the antiwear properties of the fuel are improved almost to the same level as with the addition to the fuel of antioxidants and stabilizer–dispersants. The adding to fuels for jet engines of some types of surface-active substances—phenols, alkylphenols, phenylene-diamines—makes it possible at the same time to improve their stability during storage and improve their antiwear properties. TAB

N65-22828# Auburn Univ., Ala. Dept. of Mechanical Engineering
THERMAL DIFFUSIVITY OF SOLID PROPELLANTS—DEVELOPMENT OF APPARATUS AND INITIAL TEST RESULTS Progress Report, Nov. 1963–Feb. 1964
G. E. Tanger and G. H. Nix Mar. 1964 40 p refs
(Contract DA-01-009-ORD-1023)
(PR-8; AD-457934)

Results of recent tests on the thermal conductivity of Pershing propellant are included. A transient heat-transfer system was constructed and tested in an attempt to determine the thermal diffusivity of solid propellant. Details on the construction and calibration of the apparatus are given. Also, thermal conductivity was determined for an inert propellant sample by the line-source and steady-state methods used previously. The density of the specimen was measured and the specific heat was calculated to provide a complete thermal analysis. Derivation of a series solution for the problem of transient heat flow in a semi-infinite solid is given in the appendix. The equations are programed so as to obtain a trial-and-error solution for the thermal diffusivity. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-22325# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
TRANSIENT CHAMBER PRESSURE AND THRUST IN SOLID ROCKET MOTORS
Hans H. Seidel Mar. 1965 38 p refs
(Contract AMC-11528(Z))
(R-138; AD-613962)

An analysis of solid rocket motors was made to find the chamber pressure and thrust during the transient periods of buildup and decay. The results are differential equations and solutions of closed form. Author

N65-22335# Air Force Systems Command, Edwards AFB, Calif. Air Force Rocket Propulsion Lab.
SOLID PROPELLANT ROCKET IGNITION TEST AND EVALUATION, (SPRITE) PROGRAM
Walter R. Niessn Jan. 1965 64 p refs
(AFRPL-TR-65-23; AD-461377)

The existence and characteristics of the stagnation zone formed in the port of a solid rocket motor experiencing aft-end pyrogen ignition are demonstrated. A potential overpressure hazard if aft-end pyrogen igniters are retained after the motor has reached normal operating pressure is shown. The feasibility of the Phoenix (aft-end hybrid) ignition technique for multiple ignition of end-burning solid rocket motors is proved. Author

N65-22663*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A METHOD FOR PREVENTION OF SCREAMING IN ROCKET ENGINES
Theodore Male and William R. Kerslake Washington, NACA, 19 Aug. 1954 26 p refs
(NACA-RM-E54F28a) CFSTI: HC $2.00/MF $0.50
(Declassified)

Lateral and longitudinal combustion-pressure oscillations that occurred in screaming combustion of a 1000-pound-thrust rocket engine using white fuming nitric acid and JP-4 fuel as propellants were successfully prevented by means of longitudinal fins in the combustion chamber. Fin position was critical, and complete attenuation was achieved only when the fins were located in a zone approximately 8 to16 inches from the injector. Fins located in other zones, i.e., near the injector or far downstream from the injector, did not stop the oscillations. When oscillations occurred in finned chambers, the longitudinal mode seemed more dominant than the lateral mode; in chambers without fins, the lateral mode tended to be dominant. The lateral oscillation was distorted and its intensity diminished by the fins. Fins, however, did not affect the frequencies; the longitudinal frequency varied inversely with chamber length, and lateral frequencies varied only slightly from an average of 6000 cps. Author

N65-22725 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PLASMA LASER AS A PHOTON-ROCKET ENGINE
L. I. Gudzenko and L. A. Shelepin *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 269–273 refs (See N65-22713 11-30)

A photon rocket system is proposed that would overcome some of the disadvantages of other photon rocket systems, i.e., storage of antimatter, large weight and volume of the system, and mirror losses. In the scheme proposed, the radiation of an optical quantum generator of comparatively small output is amplified by a relatively high gain optical quantum amplifier to produce a unidirectional photon flux capable of generating thrust. A plasma laser without feedback is proposed as the amplifier; upon emission of a photon, the emitting atom experiences recoil and the total impulse thus imparted to the radiating plasma is transmitted to the rocket by a magnetic field that constrains and insulates the plasma. The average thrust created by the photons in a small (effective length ~2.3 m) quantum amplifier from 1 gram of inverse hydrogen plasma is calculated to be 10^4 kg. However, the problem basic to all photon rockets—the creation of a sufficiently light and energetically condensed power source with an output in millions of kilowatts—remains to be solved. M.P.G.

N65-22779# AVCO-Everett Research Lab., Everett, Mass.
MHD TURBOROCKET ENGINE FOR RECOVERABLE LAUNCH VEHICLES
Felix Berner Mar. 1965 52 p refs
(Contract AF 04(694)-414)
(AVCO-Everett Res. Rept.-208; BSD-TR-64-183; AD-46062)

A propulsion system, representing a hybridization of an air-breathing engine and a chemical rocket, is described and

analyzed. At flight Mach numbers equal to or larger than four, this propulsion system operates substantially as two separate units, a (subsonic combustion) ramjet, and a chemical rocket. At lower flight Mach numbers the proposed propulsion system has characteristics distinctly different and superior to the characteristics of a ramjet engine and a chemical rocket operated independently and in parallel. These characteristics are due to the transfer of mechanical energy from the rocket gas jet to the aspirated or scooped air. The energy transfer is achieved by means of an MHD generator, electric motor, and turbo-compressor, whereby the generator extracts energy from the rocket gas flow and the compressor adds mechanical energy to the air. The thermodynamic cycle is similar to the cycle of an air-turborocket with the exception that the rocket gas is exhausted independently of the compressed and heated air. The incorporation of an MHD-generator instead of a turbine makes it possible to use a rocket-type gas generator delivering a gas flow of higher initial energy than the primary gas flow in ordinary turborockets, thereby permitting a higher utilization of the gas and resulting in attractive specific impulse levels. The engine performance is computed over a large range of flight speeds and altitudes, and the results are used in an investigation of possible boost missions. It is found that the hydrogen-fueled MHD-turborocket is superior to a hydrogen-fueled turbo-ramjet in boost applications. Author

N65-22931# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
SPACE PROPULSION BY PLASMA ACCELERATION TECHNIQUES
David B. Miller Dec. 1964 13 p refs Presented at Symp. on New Res. Frontiers in Phys. Electron., Michigan Univ., Ann Arbor, 3-4 Dec. 1964
(R64SD91; AD-609833)

Propulsion requirements for space missions necessitate high velocity propellant ejection in order that the total system weight not be dominated by the propellant load. Only the non-thermal, electric acceleration techniques, electrostatic and electromagnetic, are realistically capable of meeting these high velocity requirements. Of these two basic classes, the electromagnetic, or plasma, accelerators show promise for ultimate, high thrust applications because of the high energy density capability of the magnetic field. The several plasma thrustor configurations, dc, induction, pulsed and Hall current, will be considered in terms of basic features and experimental results. The comparative advantages of the pulsed and Hall-current geometries will be shown. Author

N65-23071*# Chrysler Corp., New Orleans, La. Engineering Dept.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME VIII: H-1 ENGINE AND HYDRAULIC SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Jul. 1964 32 p
(Contract NAS8-4016)
(NASA-CR-62503; SDES-64-415, Vol. VIII) CFSTI: HC $2.00/MF $0.50

A functional description of the H-1 engine is presented that comprises detailed major component descriptions and engine operations including launch preparation, engine purges, engine start, mainstage, shutdown, and drain operations. A description of the H-1 hydraulic system is also discussed with detailed major component descriptions and hydraulic system operation during prelaunch, flight, filling, and draining operations. Alpha-numerical listings of the H-1 engine and hydraulic system components that function during countdown, during vehicle flight, or in the event of a launch abort are included. G.G.

N65-23072*# Chrysler Corp., New Orleans, La. Engineering Dept.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME VIII: H-I ENGINE AND HYDRAULIC SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Apr. 1964 32 p
(Contract NAS8-4016)
(NASA-CR-62504; SDES-64-414, Vol. VIII) CFSTI: HC $2.00/MF $0.50

The H-1 engine and hydraulic system of the S-I stage of launch vehicle SA-8 are described. Data are presented in three sections: functional description, index of finding numbers, and mechanical schematic. A functional description of the engine operation includes data on prelaunch operations, engine start, bipropellant operation, engine shutdown, engine purges, and engine drain operation. Also described functionally is the hydraulic system operation which includes filling, prelaunch, flight, and drain operations. An alpha-numerical list, by finding number, of H-1 engine and hydraulic system components that function during a prelaunch countdown, during vehicle flight, or in the event of a launch abort is included. Included also is a mechanical schematic that shows the functional arrangement of H-I engine and hydraulic system components. S.C.W.

N65-23073*# Chrysler Corp., New Orleans, La. Engineering Dept.
SATURN I LAUNCH VEHICLE SA-8 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME IX: RL10A-3 ENGINE AND HYDRAULIC SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
May 1964 29 p
(Contract NAS8-4016)
(NASA-CR-62604; SDES-64-414, Vol. IX) CFSTI: HC $2.00/MF $0.50

The subsystems and components within the launch vehicle SA-8 that constitute the liquid propellant rocket engines and their independent closed-loop hydraulic systems are described. Schematic diagrams and numerical listings of engine and hydraulic system components that function during prelaunch countdown, vehicle flight, and in the event of a launch abort are included. G.G.

N65-23074*# Chrysler Corp., New Orleans, La. Engineering Dept.
SATURN I LAUNCH VEHICLE SA-10 AND LAUNCH COMPLEX 37B FUNCTIONAL SYSTEMS DESCRIPTION. VOLUME IX: RL10A-3 ENGINE AND HYDRAULIC SYSTEM FUNCTIONAL DESCRIPTION, INDEX OF FINDING NUMBERS, AND MECHANICAL SCHEMATICS
Aug. 1964 29 p
(Contract NAS8-4016)
(NASA-CR-62505; SDES-64-415, Vol. IX) CFSTI: HC $2.00/MF $0.50

A functional description of the RL10A-3S liquid-propellant rocket engine is given that contains detailed component descriptions and engine operations including engine purge, prestart chill-down, ignition, mainstage operation, and shutdown. The functional description of the RL10A-3S engine hydraulic system includes component descriptions and hydraulic system operation for hydraulic system fill, prelaunch operation, and mission operation. The alpha-numerical listings of the RL10A-3S engine and hydraulic system components that function during a prelaunch countdown or during vehicle flight are included. G.G.

N65-23153# Martin Co., Denver, Colo.
TITAN II LONG TERM OXIDIZER STORAGE Final Report
F. Weidman and R. Kannady, Jr. Feb. 1964 104 p refs
Supersedes Martin-TM-0441-384
(Contract AF 04(647)-576)
(CR-64-20; AD-430224)

The oxidizer tank was filled with nitrogen tetroxide containing a maximum allowable water content of 0.2%. During storage, periodic propellant and ullage gas samples were taken at various locations on the tank. During the first months of the test the ullage pressure fluctuated considerably. Several pressurizations were required which were attributed to unstable silo temperatures, ullage and propellant sampling, and a leak at 9 months of the test. It was concluded that the test successfully obtained all major objectives. Excessive leakage, component and tank damage which occurred in the latter stages of the storage period were a result of additional testing involving increased humidity which was not a test objective. E.E.B.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-22322# Stanford Research Inst., Menlo Park, Calif.
SURVEY OF ENERGETIC RADIATION AND METEOROIDS IN INTERPLANETARY SPACE Final Report
V. Gonzalez, G. L. Johnson, and R. La Canna Dec. 1964 170 p refs
(Contract N228-(62479)-65358)
(USNRDL-TR-812; AD-613698)

The empirical characteristics of the environmental factors affecting the design, operation, calibration, testing, and on-line performance requirements of radiation sensors intended for operation in the interplanetary environment are surveyed. The environmental factors surveyed and discussed include ionizing electromagnetic radiation, corpuscular radiation of both solar and galactic origin, and meteoroids. The survey is limited to the radiations and meteoroids existing in the region outside of the earth's magnetosphere. Where possible, the survey is based on observations made with space probes located beyond the magnetosphere. Where data from deep space probes are not available, the characteristics of the environmental factors have been estimated from measurements made at or near the surface of the earth. Author

N65-22362*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SURVEY OF THE LITERATURE ON THE SOLAR CONSTANT AND THE SPECTRAL DISTRIBUTION OF SOLAR RADIANT FLUX
M. P. Thekaekara Washington, NASA, 1965 47 p refs
(NASA-SP-74) CFSTI: HC $2.00/MF $0.50

Data currently available on the solar constant and the spectral distribution of the solar radiant flux are surveyed. The relevant theoretical considerations concerning radiation, solar physics, scales of radiometry, and the thermal balance of spacecraft were discussed. A detailed review has been attempted of the data, of the methods of data analysis, and the many revisions of the results. The survey shows that the results from different sources have wide discrepancies, that no new experimental data have been taken in recent years, and that the conventional technique of extrapolation to zero airmass leaves large uncertainties. The feasibility of further measurements and of a new method of approach was discussed. Author

N65-22398# Johannes-Gutenberg-Universitat, Mainz (West Germany). Meteorologisch-Geophysikalisches Inst.
RESEARCH ON ATMOSPHERIC OPTICAL RADIATION TRANSMISSION Scientific Report No. 3
K. Bullrich, E. de Bary, K. Danzer, R. Eiden, and K. Heger Jan. 1965 116 p refs
(Contract AF 61(052)-595)
(AFCRL-65-109; AD-612708)

The influence of absorption of the aerosol particles on the extinction of solar and sky radiation was investigated. It was found that the extinction and absorption coefficients increase for a more absorbent atmosphere, whereas the scattering coefficient decreases. The imaginary part of the complex index of refraction effects an increasing attenuation of the scattering functions and the intensities of diffuse sky radiation with increasing wavelength. Also, the radiation emerging from the top of the earth's atmosphere with Rayleigh scattering and scattering on large particles was computed. Further, it was found that the computation of the albedo at the top of the earth's atmosphere produced results which depend very much on the individual parameters: solar elevation, wavelength, turbidity of the air, and albedo of the earth's surface. E.E.B.

N65-22542*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE OF SOLAR RADIATION PRESSURE ON ORBITAL ECCENTRICITY OF A GRAVITY-GRADIENT ORIENTED LENTICULAR SATELLITE
W. F. Hodge [1965] 16 p refs Presented at Symp. on Passive-Gravity-Gradient Stabilization, Moffett Field, Calif., 10–11 May 1965
(NASA-TM-X-56549) CFSTI: HC $1.00/MF $0.50

The change in the orbital eccentricity of a passive inflatable lenticular satellite due to solar radiation pressure is investigated to determine if the change becomes large enough to cause difficulty in using gravity gradient for attitude control purposes. Numerical data for a perfectly absorptive lenticule of 200-ft radius placed in an initially circular 2000-mile orbit were calculated for a range of orbit inclinations from 0° to 113°. Corresponding data for an Echo-type sphere were also generated to provide a comparison with established results. All of the calculations cover satellite lifetimes up to 1 year. The results show that the eccentricity can increase in a year's time from an initial value of 0.001 to values ranging from 0.04 to 0.21, depending upon the orbital inclination. At present, mesh-type materials are being studied as a possible means of reducing the solar pressure perturbations. When compared on an equivalent area-to-mass-ratio basis, the effects of solar radiation pressure on the orbital eccentricities of perfectly absorptive lenticular configurations and Echo-type spheres appear nearly the same. The well-established results for spheres give a sufficiently accurate estimate of the orbital motion of a lenticular satellite having the same effective area-to-mass ratio. Author

N65-22552*# New York Univ., N. Y. Dept. of Meteorology and Oceanography
RADIATION STUDIES FROM METEOROLOGICAL SATELLITES

S. I. Rasool and C. Prabhakara (NASA. Goddard Inst. for Space Studies) Jan. 1965 36 p refs
(Grant NsG-499; Proj. Hiam)
(NASA-CR-62274) CFSTI: HC $2.00/MF $0.50

Radiation measurements made by the Tiros meteorological satellites during 1962 and 1963 were analyzed. Data for 10 months were studied for information on the latitudinal and time variations of the albedo of the earth and the outgoing terrestrial radiation in the infrared. The albedo values thus obtained give a mean reflectivity of the earth–atmosphere system of 31% for the area between the latitudes 60° N and 60° S. The oceanic regions contribute 30% while the land areas, 34%. A conspicuously high albedo of ~45% is noted over the desert regions of the Sahara and Arabia which implies a slightly negative radiative balance of these regions. The albedo values are used to derive the effective incoming radiation from the sun which is then combined with the estimates of the outgoing radiation in the infrared to obtain monthly mean radiative energy balance of the earth–atmosphere system for each 10° latitude belt between 60° N and 60° S. An attempt is then made to derive, from these data, the energy available for transport by the atmosphere and oceans. The energy distribution patterns indicate that ocean transport may be much more significant in the Southern than the Northern hemisphere. Author

N65-22584*# National Aeronautics and Space Administration, Washington, D. C.
ON THE PRESENCE OF "MINOR" COSMIC RAY FLARE EFFECT IN MAGNETO-DISTURBED DAYS [O NALICHII EFFEKTA "MALYKH" KOSMICHESKIKH LUCHEY V MAGNITNO-VOZMUSHCHENNYYE DNI]
L. I. Dorman and E. V. Kolomeyets 14 Jun. 1962 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 1, 1962 p 56–57
(NASA-TT-F-8240)

The effect of cosmic-ray increase during magneto disturbed days is, as an average, practically absent, or at least three to four times lesser than in quiet days. This is shown by the method of epoch superimposition by numerous chromospheric flares of force 2 and higher. Discussed are the possible causes of such phenomena. Author

N65-22586*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF THE SIDEREAL-DAILY VARIATION OF COSMIC RAY INTENSITY [OB IZMERENII ZVEZDNOSUTOCHNOY VARIATSII INTENSIVNSOTI KOSMICHESKIKH LUCHEY]
Ya. L. Blokh Jun. 1962 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 2, 1962 p 364–365
(NASA-TT-F-8247) CFSTI: HC $1.00/MF $0.50

A technique for measuring sidereal-daily variations in cosmic-ray showers of galactic origin is discussed. The technique is based on the fact that the amplitude of solar-daily variation drops as the energy increases, whereas the amplitude of the sidereal-daily variation increases and is independent of energy. Simultaneous registration, at a point of 45° geographic (N) latitude, of oblique cosmic-ray showers originating from the southerly and northerly directions at a 45° angle to the vertical, was used to gather galactic data. The oblique showers originating from the north gave information from a specific portion of the galaxy as the earth rotated, while the frequency of showers originating from the south reflected the radiation anisotropy in the galaxy plane. Since the atmospheric solar-daily variation is identical for both showers and the sidereal-daily variation is absent in the northern showers, the south–north difference provides the true value for the sidereal-daily variation. The technique provides the possibility of a reliable registration of sidereal variation of broad atmospheric showers, which in turn will contribute substantially to the solution of the cosmic-ray origin. L.S.

N65-22589*# National Aeronautics and Space Administration, Washington, D. C.
POSSIBILITY OF EXISTENCE OF HIGH ELECTRON CONCENTRATIONS IN THE NIGHT ATMOSPHERE OF VENUS [O VOZMOZHNOSTI SUSHCHESTVOVANIYA V NOCHNOY ATMOSFERE VENERY VYSOKIKH ELEKTRONNYKH KONTSENTRATSIY]
A. D. Danilov and S. P. Yatsenko Jun. 1962 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 2, 1962 p 363–364
(NASA-TT-F-8244) CFSTI: HC $1.00/MF $0.50

The presence of high electron concentrations in the night atmosphere of Venus was investigated in order to explain the high temperatures of the emitting regions that were found by radio observations in the 10-cm wavelength. A model of the Venus ionosphere was constructed on the basis of similar ionization and recombination processes in the terrestrial atmosphere. Comparison with the number of recombinations in the night ionosphere of the Earth led to the assumption that the same ionizing agent acts in the Venus as in the Earth's night atmosphere. The flux of that agent seems to be several times greater in the Venusian atmosphere. G.G.

N65-22590*# National Aeronautics and Space Administration, Washington, D. C.
EARTH'S RADIATION BELTS AT 180–250 KM HEIGHTS [RADIATSIONNYYE POYASA ZEMLI NA VYSOTAKH 180–250 KM]
S. N. Vernov, I. A. Savenko, P. I. Shavrin, V. E. Nesterov, and N. F. Pisarenko 17 Jun. 1962 13 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 1, 1962 p 41–47
(NASA-TT-F-8242) CFSTI: HC $1.00/MF $0.50

The scintillating and gas-discharge counters installed aboard the third spaceship permitted the study of the distribution of ionizing radiations in the 180- to 250-km altitude range, the establishment of the position and intensity of radiation belts at these altitudes, and a comparison with the results of similar measurements in the 307- to 339-km altitude range, obtained during the flight of the second spaceship. Author

N65-22591*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF THE ABSORPTION OF COSMIC RADIOEMISSION DURING THE SOLAR ECLIPSE OF FEB. 15, 1961 [IZMERENIYA POGLOSHCHENIYA KOSMICHESKOGO RADIOIZLUCHENIYA VO VREMYA SOLNECHNOGO ZATMENIYA 15.II.1961 g.]
G. M. Artem'yeva, V. V. Belikovich, E. A. Benediktov, L. M. Yerukhimov, and Yu. S. Korobkov Jun. 1962 8 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 1, 1962 p 58–60
(NASA-TT-F-8243) CFSTI: HC $1.00/MF $0.50

The results are presented of measurements of cosmic radioemission in the ionosphere in the frequencies of 13, 186, and 25 Mc/s according to observations conducted in Yevpatoria and Gor'kiy during the period of the February 15, 1961 solar eclipse. Author

N65-22594*# National Aeronautics and Space Administration, Washington, D. C.
CORPUSCULAR HYPOTHESIS FOR THE IONIZATION OF THE NIGHT IONOSPHERE [KORPUSKULYARNAYA GIPOTEZA IONIZATSII NOCHNOY IONOSFERY]
L. A. Antonova and G. S. Ivanov-Kholodnyy 18 Apr. 1962 19 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 1, no. 2, 1961 p 164–173
(NASA-TT-F-8212) CFSTI: HC $1.00/MF $0.50

On the basis of data on the distribution of electron concentration in the region of the F-layer of the night ionosphere at middle latitudes, and considering that it is basically conditioned by fluxes of soft electrons, the effective energy and the intensity of the electron flux are estimated, with the electron energy spectrum computed at the same time. The spectrum computed in the region with energies from 100 to $5 \cdot 10^4$ eV, may be approximated by the power function $E^{-\gamma}dE$ with $\gamma \sim 4$. The kind of the obtained spectrum agrees well with the energy spectra of electrons in the region of high energies, constructed according to current experimental data. Author

N65-22597*# National Aeronautics and Space Administration, Washington, D. C.
IDENTIFICATION OF SUN'S EMISSION LINES IN THE SHORTWAVE REGION OF THE SPECTRUM ($\lambda \leq 1100$ Å) [OTOZHDESTVLENIYE LINIY IZLUCHENIYA SOLNTSA V KOROTKOVOLNOY OBLASTI SPECTRA ($\lambda \leq 1100$ Å)]
G. S. Ivanov-Kholodnyy and G. M. Nikol'skiy Aug. 1962 31 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 3, 1962 p 425–442 Presented at the Cospar Space Sci. Symp., Washington, D.C., May 1962
(NASA-TT-F-8262) CFSTI: HC $2.00/MF $0.50

An investigation is conducted of 180 out of more or less 225 emission lines of the Sun observed with the aid of rockets in the region from 60 to 1100 Å. The spectral distribution of Sun's shortwave energy was constructed. Maxima were detected in the 60 to 100 Å wavelength region (corona), the 200 to 450 Å region (upper part of transition region), and also in the regions of 550 to 650, 750 to 850, 950 to 1050 Å. The total energy of line emission, constituting near the Earth not less than 15 erg/cm^2 sec, is estimated for $\lambda \leq 1100$ Å. It is shown that the relative nitrogen content in the sun is $[N]/[H] = 3 \cdot 10^{-5}$. The compilation of lines proposed in the table, constitutes at present the most complete theoretical list of wavelengths and intensities of bright lines in the shortwave spectrum of the Sun. The results of comparison of the theoretical data of the forecast with the experimental data are also brought out. Author

N65-22601*# National Aeronautics and Space Administration, Washington, D. C.
MAGNETIC MEASUREMENTS ABOARD AN AUTOMATIC INTERPLANETARY STATION TOWARD VENUS [MAGNITNYYE IZMERENIYA AVTOMATICHESKOY MEZHPLANETNOY STANTSII K VENERE]
Sh. Sh. Dolginov, E. G. Yeroshenko, L. N. Zhuzgov, and N. V. Pushkov Jun. 1962 7 p Transl. into ENGLISH from Geomatnetizm i Aeronomiya (Moscow), v. 2, no. 1, 1962 p 38–40
(NASA-TT-F-8239) CFSTI: HC $1.00/MF $0.50

Compared are field variations aboard an automatic interplanetary station (AIS) in the 165 to 175 thousand-km range with field variations at a middle-latitude magnetic observatory. Readings of a magnetograph, and of the AIS's charged particle traps at a distance of 1900 thousand km from the earth are compared with the variations of the field and of the intensity of cosmic rays' neutron component at the earth's surface. Expressed is the assumption, that the disturbance observed on the ground is not related to the stream's frozen-in magnetic fields, but is the result of transformation of the stream's kinetic energy within the bounds of the magnetic field. Author

N65-22626*# Consultants and Designers, Inc., Arlington, Va.
TO THE THEORY OF CHARGED PARTICLE SCATTERING BY COSMIC MAGNETIC FIELDS OF SIMPLEST TYPES [K TEORII RASSEYANIYA ZARYAZHENNYKH CHASTITS KOSMICHESKIMI MAGNITNYMI POLYAMI PROSTEYSHIKH TIPOV]
L. I. Dorman and Yu. G. Nosov 4 May 1965 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 155–158
(Contract NAS5-3760)
(NASA-TT-F-9674; ST-PF-CR-1036) CFSTI: HC $1.00/MF $0.50

The propagation of cosmic rays in interstellar and interplanetary media is often viewed as a process of relativistic particle diffusion on magnetic inhomogeneities. Considered in the present work are the scattering properties of magnetic fields of simplest configurations H = const and $H \approx r^{-n}$, that would be adaptable to the diffusive process of charged particle propagation. Methods are developed for these scatterers, usually applicable in the theory of atomic collisions, i.e., finding of the effective differential cross section, and also of total cross section. A two-dimensional case is considered, whereby charged particles flow in a plane, and the vector of H is always directed perpendicularly to that plane. Author

N65-22632*# National Aeronautics and Space Administration, Washington, D. C.
TRAPPED RADIATION EXPERIMENT
James A. Van Allen, Louis A. Frank, Stamatios M. Krimigas, and Kent Hills (State Univ. of Iowa) 19 Apr. 1965 4 p Presented at the 46th Conv. of the Am. Geophys. Union, Washington, D. C., 19 Apr. 1965
(NASA News Release-65-117-C) Available from the Scientific and Technical Information Division

The trapped radiation experiment on Mariner IV is described by the National Aeronautics and Space Administration. Two tubes are able to detect protons greater than 500 000 electron volts and electrons greater than 40 000 electron volts; a third tube detects protons above 3.1 million electron volts and electrons above 150 000 electron volts. A solid state detector measures protons in the 500 000 to 11 million electron volts, and in the 880 000 to 4 million electron volts range. This trapped radiation detector reported sharp increases in radiation on January 8 and 12, and on February 5, 1965. Readings were obtained in the outer fringes of the earth's magnetosphere as far as 92 000 miles away. A comparison with measurements from Mariner II showed that the Mariner IV detector recorded much less radiation, probably due to the quiet period of the sun. G.G.

N65-22650*# Consultants and Designers, Inc., Arlington, Va.
ON THE ORIGIN OF HARD X-RAY AND RADIO EMISSION DURING THE SOLAR FLARE OF 21 SEPTEMBER 1961 [O PROISKHOZHDENII ZHESTKOGO RENTGENOVSKOGO IZLUCHENIYA I RADIOIZLUCHENIYA PRI SOLNECHNOY VSPYSHKE 28 SENTYABRYA 1961]
A. A. Korchak 10 Apr. 1965 14 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 32–39
(Contract NAS5-3760)
(NASA-TT-F-9665; ST-SP-PF-10316) CFSTI: HC $1.00/MF $0.50

The burst of X-rays during the flare of September 21, 1961 can be satisfactorily explained by bremmstrahlung of non-relativistic electrons with $E_k \geq 20$ keV, with an exponential energy spectrum $\sim E_k^{-3}$. The lower limit of particle concentration in the emitting region is found to be equal to $\approx 10^{10}$ cm^{-3}. In order to explain the observed flux, N_e (≥ 20 keV) $= 3 \cdot 10^{35}$ electrons are required. If the spectrum of electrons is extended into the region of relativistic energies, the observed centimeter radioburst can be explained and the intensity of the magnetic field can be estimated and found to be equal to 160 Oe. For the sake of comparison, an analogous computation is made for the flare of March 20, 1958. Author

N65-22651*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ORIGIN OF SOLAR FLARES AND THE ACCELERATION OF CHARGED PARTICLES
Donat G. Wentzel (Michigan Univ.) [1963] 33 p refs
(NASA-TM-X-55211; X-640-63-204) CFSTI: HC $2.00/MF $0.50

Various theories concerning solar flares are briefly reviewed. Major considerations are (1) the creation of magnetic energy through the energy radiated by a large flare, and (2) the rapidity with which the magnetic energy is converted to radiation. Also discussed are the observed phenomena associated with optical flares which involve more energy than the optical emission has. These arguments show that the location of particle acceleration is the injection energy. It was concluded that the discussed theories explain only one type of particle and cannot be convincing unless several phenomena associated with a flare are included. No theory naturally explains the duration of the solar flare and the shape of the light curve. G.G.

N65-22717 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF SOFT-ELECTRON FLUXES IN THE UPPER ATMOSPHERE USING A SECONDARY-ELECTRON MULTIPLIER
L. A. Antonova, G. S. Ivanov-Kholodnyy, N. D. Masanova, and V. S. Medvedev *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 125–136 refs (See N65-22713 12-30)

The instrument described has a secondary-electron multiplier and is designed to register fluxes of soft electrons in the upper atmosphere; preliminary results from an experiment are submitted. The total intensity of the electron stream measured at altitudes of 200 to 500 km, was found to be $\sim 5 \cdot 10^7$ electrons $\cdot cm^{-2} \cdot sec^{-1} \times$ steradian^{-1}. Author

N65-22721 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ELECTRON INTENSITY OF THE RADIATION BELTS AT ALTITUDES OF 180–330 km IN REGIONS CONJUGATE WITH NEGATIVE GEOMAGNETIC ANOMALIES
S. N. Vernov, I. A. Savenko, L. V. Tverskaya, B. A. Tverskoy, and P. I. Shavrin *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 203–215 refs (See N65-22713 12-30)

According to data obtained from the second and third Soviet orbiting spacecraft, the asymmetry of the electron intensity of the radiation belts was investigated at conjugate points for the case in which one of these points is situated beneath the ground. The intensity of such points was investigated in the Northern Hemisphere in the region conjugate to the South Atlantic anomaly, and in the Southern Hemisphere, in the region conjugate to the Bering anomaly. An estimate of particle leakage with consideration of this phenomenon is presented, and the problem of the limits of applicability for the concept of the mirror point of a particle is discussed, with consideration of Coulomb scattering. It is demonstrated that the dense layers of the atmosphere can in all probability reflect electrons with small pitch angles. The effect of intensity asymmetry is most likely associated with the processes of particle acceleration at low altitudes. If the observed counting rate is due to the bremsstrahlung of electrons with energies ≤ 50 to 100 keV, the effect may be explained by the Coulomb diffusion of particles from the outer radiation belt. Author

N65-22802# Emmanuel Coll., Boston, Mass. Research Language Center
THE ASYMMETRICAL EFFECT OF THE FLARE POSITION ON GEOMAGNETIC ACTIVITY
Gong-liang Zhang Bedford, Mass., AFCRL, Apr. 1964 21 p Transl. into ENGLISH from Acta Geophys. Sinica (Peking), v. 12(1), 1963 p 32–40
(Contract AF 19(628)-3869)
(E-T-CH-64-10; AD-611031)

Flares of importance > or = II(+) are grouped according to their heliographic position and magnetic condition of the active regions. Using the "superposed-epoch method", the mean daily frequency for $K_p >$ or = 6 under different conditions is calculated. It is found that for the magnetic group $\beta\gamma + \gamma + \beta_f$, solar flares in the Northern Hemisphere produce a stronger corpuscular effect than those in the Southern, but for the flares in the $\beta_p + \beta$ regions, no such hemispheric asymmetry is found. Also, in the Southern Hemisphere, western flares have a stronger effect than the central and eastern ones, but in the Northern Hemisphere, only those in the $\beta_p + \beta$ regions have such an East-West asymmetry. These asymmetrical relations appeared in all of the last three sunspot cycles and were especially conspicuous during the equinoxes. Author

N65-22941# Durham Univ. (England). Dept. of Physics
COSMIC RAY SEA LEVEL MOON INTERACTIONS Final Technical Report
F. Ashton, P. K. Mac Keown, J. B. M. Pattison, and A. W. Wolfendale 5 Oct. 1964 51 p refs
(Grant AF-EOAR-62-117)
(AFCRL-65-23; AD-610726)

The horizontal spectrograph was used in conjunction with a large liquid scintillation counter to examine the rate of energy loss of muons at high momenta. Slight evidence for a reduction was found, the magnitude smaller than predicted. Further measurements made on the charge excess of muons confirm earlier results, which showed a large excess even at the highest energies. Alternative explanations in terms of isobar generation and kaon production are considered. Similarly, the inclined spectrum measurements were extended; by comparison with the vertical spectrum, more precise limits were set on the relative production of kaons and pions in high energy collisions. Other experiments were examined and it was concluded that if the energy spectra of pions and kaons are nearly the same, then the K/π ratio is about 25% over the energy range 50 to 10^6 GeV. Author

N65-23014*# National Aeronautics and Space Administration, Washington, D. C.
IONIZATION EXPERIMENT
H. Victor Neher and Hugh R. Anderson (JPL) 19 Apr. 1965 4 p
(NASA News Release-65-117-E) Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration discusses the findings from the ionization chamber and the Geiger–Mueller tube on radiation entering our solar system from galactic sources during the Mariner IV space flight. Tube measurements on the solar flare of February 5 showed an increase in radiation of 80 times above the normal interplanetary intensity; the ion chamber readings were 200 times normal. It is believed that these radiation levels are related to the quiet period of the sun and the absence of a strong interplanetary magnetic field induced by solar winds. Both probes failed in March 1965, probably due to power supply difficulties. G.G.

N65-23054# Max-Planck-Institut für Aeronomie, Lindau über Northeim (West Germany). Institut für Stratosphärenphysik
THE ANISOTROPES OF COSMIC RADIATION [DIE ANISOTROPIEN DER KOSMISCHEN STRAHLUNG]
Erhard Kirsch Berlin (New York), Springer, 1964 73 p refs in GERMAN /ts Mitt.–16

The local-time intensity distribution of neutrons from cosmic radiation was investigated through evaluation of data from international geographic year observations of the period July through December 1961. Harmonic analysis and graphical curves of neutron or meson registration data over a 2-hr period were used to evaluate the observed anisotropies, and to find the amplitude and phase values for several electromagnetic observation stations. A good correlation was shown between isotrope modulation and earth magnetism, but the diurnal variation amplitude and phase of the nuclear component from cosmic radiation was nonlinear. A formula for the isotrope modulation mechanism of primary diurnal variation was derived:

$$\frac{\delta D(E)}{D(E)} E^{-30.3 \pm 0.2}$$

where the primary energy spectrum is D(E) and the value of the energy spectrum exponent is $-0,3 \pm 0,2$. Transl. by G.G.

N65-23110# Rochester Univ., N. Y. Dept. of Physics and Astronomy
HIGH ENERGY COSMIC GAMMA RADIATION
E. M. Hafner and G. Share [1964] 70 p refs Sponsored by AFOSR and NSF
(AD-611330)

A sequence of 10 balloonborne experiments was designed to detect gamma rays by conversion in lead. The counter telescopes were sensitive to radiation from directions near zenith; nominal acceptance cones of 10°, 30°, and 60° were used. Seven of the flights produced useful data at high altitude, with results in three classes: an isotropic background flux of at least 6×10^{-4} γ/cm^2-sec-ster which may be of primary origin; an anomalous flux from 20 hr right ascension and +30° declination, with an intensity of at least 2×10^{-4} γ/cm^2-sec; and several short time variations of gamma-ray and charged particle fluxes. There is as yet no explanation for the time variations, but similar effects have recently been reported from another experiment at lower energy. Author

N65-23164*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CORPUSCULAR STREAMS RELATED TO SOLAR M-REGIONS
Tatsuzo Obayashi Washington, NASA, May 1965 14 p refs Presented to the Inter-Union Comm. on Solar Terrest. Relations, Hamburg, 24 Aug. 1964
(NASA-TN-D-2790) CFSTI: HC $1.00/MF $0.50

Recent studies on 27-day recurrence geomagnetic disturbances and their associated phenomena during the decline phase of the present sunspot cycle are summarized. An identification of M-region with solar phenomena was made by evaluating the velocity of solar winds. Discussions are given on various existing hypotheses of corpuscular streams producing M-disturbances. Author

N65-23194*# RAND Corp., Santa Monica, Calif.
ON THE STABILITY AND STRUCTURE OF SHOCK WAVES IN INTERPLANETARY SPACE
F. L. Hinton Apr. 1965 43 p refs
(Contract NASr-21)
(NASA-CR-62521; RM-4490-NASA)

Postulating the structure of shock waves in a low-density plasma, several features of interplanetary shock waves observed by satellites and space probes are explained. Unsteady flow behind the shock wave is shown to be caused (when the pressure there is anisotropic and satisfied the condition

$$\frac{P_{\parallel} - P_{\perp}}{B^2/4\pi} > 1)$$

by the refraction of small-amplitude disturbances through the shock. The shock wave is stable, however, with respect to small perturbations in the fluid variables, because the problem of small-amplitude disturbances refraction through a fast hydromagnetic shock wave has a unique solution. The length for the unsteady flow's onset, characteristically a few ion cyclotron radii, agrees with the experimental data. A possible explanation is offered for the increase in the flux of low-energy electrons seen by Explorer XII as the satellite passed inward behind the earth's bow shock on September 13, 1961. Author

N65-23242# Joint Publications Research Service, Washington, D. C.
SOLAR CORPUSCLES AND THE INTERPLANETARY MEDIUM
E. R. Mustel 7 May 1965 15 p Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), no. 30, 1963 p 19–24
(JPRS-29977; TT-65-30937) CFSTI: $1.00

Scientific data from instrument observations and other astronomical information were used to construct a model of interplanetary space. The structure of the solar atmosphere was divided into the innermost photosphere of several hundred kilometer thickness, the chromosphere extending a distance of 15000 kilometers above the photosphere, and the solar corona which extends beyond the earth's orbit. Recordings of corpuscular streams by satellites established virtually a continuous emission of corpuscles from the sun which in turn cause geomagnetic disturbances. This continuous flow of gases from the sun is independent of the existence of active regions and constitutes the main gas component of the interplanetary medium. The existence of transverse and perpendicular magnetic fields in relation to the plane of the ecliptic were also considered, as were the more or less well-defined relatively stationary corpuscular streams which constitute groups of stable elastic coronal tube-rays that develop after the formation of an active region on the sun. G.G.

N65-23250*# National Aeronautics and Space Administration. Washington, D. C.
HYPOTHESIS OF SOLAR CORPUSCULAR STREAMS WITH FORCE-FREE MAGNETIC FIELDS [GIPOTEZA O KORPUSKULYARNYKH SOLNECHNYKH POTOKAKH S BESSILOVYMI MAGNITNYMI POLYAMI]

E. I. Mogilevskiy Jul. 1962 19 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 2, no. 1, 1962 p 48–55
(NASA-TT-F-8257) CFSTI: HC $1.00/MF $0.50

A hypothesis is expounded of solar corpuscular streams acquiring in the magnetic field of active regions a force-free magnetic field. The latter determines the stability of the stream at its generation and flow from the Sun toward the Earth. The magnetic energy of such a stream exceeds its kinetic energy. The conditions of outflow of the stream are determined by the interaction with the varying magnetic field of the active region. The structure in the interplanetary space of a corpuscular stream with a force-free magnetic field is examined. The qualitative scheme of such interaction of a geoeffective stream with the magnetosphere and the Earth's ionosphere is analyzed. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-22261# Lockheed-California Co., Burbank. Astronomical Sciences Lab.
RESEARCH ON SOLAR MAGNETIC FIELDS Annual Status Report, 1 Oct. 1963–30 Sep. 1964
D. S. Webber 19 Oct. 1964 4 p ref
(Contract Nonr-3933(00); ARPA Order 215)
(LAC-433034; AD-456921)

Magnetic region classification and area estimate data were prepared. Central meridian passage dates for August 1959 through December 1962, calcium-plage data, flare summary data, and calcium and hydrogen alpha solar images were analyzed. All calcium plages and sunspot regions corresponding to specific magnetic regions were tabulated and synoptic charts and 27-day equal area projections were constructed from the isogauss maps produced from the original magnetograms. Power spectrum analysis of the data indicates that active regions corresponding to bright calcium plages on the sun have preferred spacings at harmonic intervals on the solar sphere. These regions occur preferentially at intervals 1/2, 1/3, 1/4, 1/5, ...1/10... of the solar sphere. The findings correlate similar results of cosmic radio noise absorption measurements. A consistent pattern of magnetic region development relative to the supergranular structure of calcium was observed, and the behaviors of clusters of regions was studied. Integrations of the total flux of the magnetic field over 10° strips in longitude are being carried out over 5 solar rotations to obtain a picture of the sun as a magnetically variable star. L.S.

N65-22394# Texas Univ., Austin. Electrical Engineering Research Lab.
MILLIMETER STUDIES IN RADIO ASTRONOMY Final Report, 1 Jan. 1963–1 Jan. 1965
C. W. Tolbert and A. W. Straiton Bedford, Mass., AFCRL, 31 Mar. 1965 46 p refs
(Contract AF 19(628)-1679)
(EERL-6-62; AFCRL-65-82; AD-613083)

The investigations of 94-Gc solar emission during the July 20, 1963 solar eclipse were restricted by inclement weather. No systematic limb brightening was observed; radiation, approximately 6 seconds after occultation, was observed from the southeastern limb at the position of a prominence. Tau A (35 Gc) and Sgr A (35 Gc) flux densities were 420 ±60 × 10^{-26} w/m^2/cps and 290 ±100 × 10^{-26} w/m^2/cps, respectively. The flux density of Tau A (70 Gc) interpreted from an antenna temperature signal to noise ratio of approximately 2 to 1 was 790 ±450 × 10^{-26} w/m^2/cps. Observations of 94 Gc of Sgr A, having a calculated antenna temperature standard deviation of 0.2° C, revealed no source of radiation at the central position of Sgr A (35 Gc). The 35-Gc position of Tau A and Sgr A coincided, within the limits of the measuring accuracy ±3^s R.A. and ±1' Dec., with lower frequency source positions. Author

N65-22418# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A CONTOUR MAP OF THE MOON
C. L. Goudas Oct. 1964 42 p refs *Its* Mathematical Note No. 369
(DI-82-0376; AD-607570)

The lunar elevation data provided by Schrutka–Rechtenstamm supplemented by similar data near the limbs provided by Davidson and Brooks, were used to determine the equation of surface of the moon as a sum of spherical harmonics including terms up to the eighth order. This equation was used to construct a contour map of the moon. This work was repeated for data provided by Baldwin which were supplemented by the same data by Davidson and Brooks. The two maps have some basic similarities. After improving the equation of surface derived from Schrutka's data in a way that a homogeneous moon with this equation of surface would also satisfy the conditions, f = 0.633 (Koziel, 1964), β = 0.0006267 (Jeffreys, 1959), γ = 0.0002274 (Jeffreys, 1961), a third contour map was derived. This seems to be more realistic than the previous two. Author

N65-22453# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
SOLAR TEMPERATURE MEASUREMENTS AT 15 AND 35 Gc
K. N. Wulfsberg and J. A. Short Feb. 1965 16 p refs
(AFCRL-65-75; AD-613322)

Solar temperatures measured at 15 and 35 Gc over a 9-month period indicate that the temperatures are sufficiently stable with time to warrant using the sun as a source for measuring total atmospheric attenuation at these frequencies. The average disk temperature was 15 100° K at 15 Gc and 10 420° K at 35 Gc. All measurements fell within ±5% at 15 Gc and within ±3% at 35 Gc, the variations being due principally to measurement errors. Measurements were also made during the solar eclipse of July 20, 1963. Author

N65-22541*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EARTH'S MAGNETIC TAIL
Norman F. Ness 28 Jan. 1965 58 p refs Presented at the 2d Benedum Conf. on Earth Magnetism, Pittsburgh, 23 Nov. 1964 Submitted for Publication Revised
(NASA-TM-X-55164; X-612-64-392, Rev.) CFSTI: HC $3.00/MF $0.50

Measurements of the magnetic field of Earth at distances greater than approximately 7 R_e (Earth Radii) were performed. The geomagnetic field is observed to trail out far behind the earth in the antisolar direction, forming a magnetic tail. Magnetic field strengths of approximately 10 to 30 gammas are

observed out to satellite apogee. The diameter of the magnetosphere at a distance of 30 R_e behind the Earth is approximately 40 R_e. The direction of the field is parallel to the Earth–Sun line and in the antisolar direction below the solar magnetospheric equatorial plane and in the solar direction above this plane. A neutral surface separating antisolar directed fields in the southern hemisphere from solar directed fields in the southern hemisphere from solar directed fields in the northern hemisphere has been detected over a large extent in area. No termination of the magnetic tail is detected or suggested by the data. Author

N65-22568# Library of Congress, Washington, D. C. Aerospace Technology Div.
SURFACE CHARACTERISTICS OF THE MOON, MARS, AND VENUS. ANNOTATED BIBLIOGRAPHY
1 Mar. 1965 81 p ref
(ATD-P-65-12; AD-458260) CFSTI: HC $3.00/MF $0.75

An annotated bibliography of the surface characteristics of Mars, Venus, and the Moon is presented with emphasis on light polarization and albedo measurement techniques as well as radio-astronomical studies. Information on tektites is also presented. The report covers 125 research studies from the years 1960 to mid-1963. More recent findings from about mid-1963 through mid-1964 are included in appendixes A to C. G.G.

N65-22579*# National Aeronautics and Space Administration, Washington, D. C.
CIRCUMPLANETARY EXPLORATION OF ATMOSPHERES [EXPLORATION CIRCUMPLANETAIRE DES ATMOSPHERES]
F. Link (Acad. of Sci., Prague) 15 May 1962 8 p refs Transl. into ENGLISH from the French paper presented at the COSPAR Symp., Washington, D. C., May 1962
(NASA-TT-F-8219) CFSTI: HC $1.00/MF $0.50

The theory of using a spaceship to make photometric observations of a star during its occultation by Venus or Mars is discussed, and application of this theory for deriving the optical properties of these planetary atmospheres is described. The occultation's photometric curve for each case was computed from the general transmission factor as a function of the luminous ray passing at a minimum altitude, the exponential atmosphere of low density, and the spaceship's position. Numerical examples relative to Mars and Venus are given, and the respective photometrical curves are shown on plots. Adaptation of a simple model of homogenous layer, from the ground to the altitude of 50 km and with the optical density at zenith being 0.03, was used in a study of Mars' dust layer. It was found that the presence of the dust layer modifies the pattern of the occultation considerably. G.G.

N65-22583*# National Aeronautics and Space Administration, Washington, D. C.
INTERPOLATIVE-ANALYTICAL THEORY OF THE MOTION OF CERES
M. S. Yarov-Yarovoy May 1962 121 p refs Transl. into ENGLISH from Tr. Gos. Astron. Inst. (Moscow), v. 28, 1960 p 25–90
(NASA-TT-F-8224) CFSTI: HC $4.00/MF $1.00

The theory of the interpolative-averaging variant of the three-point problem was applied to the construction of the intermediate orbit of the small planet Ceres. An interpolation-analytical theory of perturbed motion of an asteroid was developed on the basis of the orthointerpolational triply averaged variant of the limited three-dimensional elliptical three-point problem, and successfully used to construct an approximate intermediate theory of the perturbed motion of Ceres. This theory had a mean square error of 98 in. in direct ascension and 115 in. in declination. G.G.

N65-22596*# National Aeronautics and Space Administration, Washington, D. C.
RADAR OBSERVATION OF VENUS
V. A. Kotel'nikov, V. M. Dubrovin, M. D. Kislik, E. B. Korenberg, V. P. Minashin et al Oct. 1962 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 145, no. 5, 1962 p 1035–1038
(NASA-TT-F-8301) CFSTI: HC $1.00/MF $0.50

The final results of radar observations of Venus during April 1961 are presented. The radar transmitted rectangular pulses separated by the same duration intervals at a frequency of ~700 Mc/sec, and the reflected spectrum represented the sum of narrowband and wideband components. The narrowband component was caused by the reflections of the transmitted signal from the surface of Venus and did not exceed several cps. The width of the broadband amounted to several hundred cps and is explained as a result of strongly ionized fluxes moving relative to Venus at velocities ±40 m/sec or even faster. The ionization of these fluxes must be much greater than in the earth's ionosphere. G.G.

N65-22640# Tartu Astronoomia Observatooriumi (USSR).
THE EQUATIONS FOR ESTIMATING GALACTIC PARAMETERS IN THE VICINITY OF THE SUN [URAVNENIYA DLYA OPREDELENIYA SISTEMY OKOLOSOLNECHNYKH GALAKTICHESKIKH PARAMETROV]
S. A. Kutuzov 1964 27 p refs In RUSSIAN; ENGLISH summary *Its* Commun. No. 9

The deduction of the equations relating galactic parameters to each other is considered and the possibility of their application is discussed. Most of the equations were obtained from the hydrodynamical equations previously published by others. These hydrodynamical equations were considered to be valid for the individual populations of the galaxy. The system considered consists of six equations for each population and of two equations common for all populations. Further, there are nine parameters and eight individual parameters for each population. E.E.B.

N65-22652 Royal Greenwich Observatory, Herstmonceux (England).
STUDIES IN THE MAGELLANIC CLOUDS. VII: DISTRIBUTION OF FAINT STARS OF VARIOUS COLOURS IN SELECTED AREAS OF THE LMC
Richard Woolley and Elizabeth Epps London, HMSO, 1965 18 p Prepared jointly with Royal Obs., Cape of Good Hope, S. Africa
(Rept.-90) HMSO: 3s

Photometric measures in B and V of stars brighter than V = 16^m.5 in selected areas of Variable Field I of the Large Magellanic Cloud are described. A discussion of proper-motion measurements for stars brighter than V = 14^m.5 indicates that nearly all of the stars in the color range $+0^m.5 \leq B\text{-}V < +1^m.5$ are galactic foreground stars. Star counts are described which indicate that this result extends to fainter stars. A cepheid variable was newly discovered in one of the areas. Author

N65-22658*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ROCKET TRAJECTORY OPTIMIZATION Final Technical Summary Report, Mar. 1961–Dec. 1964

H. Hinz Apr. 1965 26 p refs
(Contract NAS8-1549)
(NASA-CR-62442; RE-208) CFSTI: HC $2.00/MF $0.50

Three types of trajectory problems were investigated: interplanetary low thrust, geocentric low thrust, and geocentric high thrust. A successive approximation technique was used to compute three-dimensional, optimal, low thrust, Earth to Mars trajectories. Two computer programs developed—for constant thrust applications and for variable thrust-limited problems—generate planetary ephemeris information, and optimize the trajectories for rendezvous and intercept missions. Optimum, geocentric, low thrust, orbital transfers were computed using gradient-type methods and a generalized Newton–Raphson method. Circle-to-circle transfers involving up to 26 revolutions about the earth were calculated with the Newton–Raphson technique. Optimum, geocentric, high thrust, orbital transfer was treated also using both the successive approximation techniques. The generalized Newton–Raphson method had to be extended to handle inequality constraints on the thrust magnitude control variable. Author

N65-22713# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC RESEARCH, VOLUME 3, NO. 2, 1965
L. I. Sedov, ed. 1 Apr. 1965 292 p Transl. into ENGLISH of Kosmich. Issled. (Moscow), v. 3, no. 2, 1965 p 3–174
(FTD-TT-65-170/1+2; AD-613179)

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10. INVESTIGATION OF MOVEMENT COORDINATION WHEN WRITING UNDER CONDITIONS OF SPACE FLIGHT A. I. Mantsvetova, I. P. Neumyvakin, V. F. Orlova, V. A. Trubnikova, and I. M. Freydberg p 228–255 refs (See N65-22723 12-05)

11. REACTION OF IRRADIATED ORGANISM WHEN AFFECTED BY ACCELERATION OF CRITICAL MAGNITUDE B. I. Davydov, V. V. Antipov, and P. P. Saksonov p 256–268 refs (See N65-22724 12-04)

12. THE PLASMA LASER AS A PHOTON-ROCKET ENGINE L. I. Gudzenko and L. A. Shelepin p 269–273 refs (See N65-22725 12-28)

13. DIRECT MEASUREMENTS OF CHARGED-PARTICLE CONCENTRATION IN THE STRATOSPHERE AND MESOSPHERE Yu. A. Bragin p 274–281 refs (See N65-22726 12-13)

14. A TRANSISTORIZED ELECTROMETRIC AMPLIFIER FOR MEASURING WEAK CURRENTS FROM CHARGED-PARTICLE DETECTORS N. N. Goryunov, B. I. Savin, and E. N. Sosnovets p 282–286 (See N65-22727 12-14)

N65-22714 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LINEARIZED THEORY OF OPTIMAL MULTI-IMPULSE COPLANAR TRANSFER
G. Ye. Kuzmak *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 1–37 refs (See N65-22713 12-30)

The general theory of multi-impulse coplanar transfers is presented on the assumption that the motion is taking place within a rather limited layer of a central field, at velocities close to circular speed. The derived theory is used for a detailed examination of the problem of optimal transfers from an initial elliptical orbit to some point from the standpoint of power; there is also a consideration of the problem of optimal transfers between arbitrary coplanar orbits. All solutions for the extremal equations were found and the parameters of the most economical optimal transfers are indicated. Author

N65-22715 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ASYMPTOTICS OF EQUATIONS OF CELESTIAL MECHANICS SUITABLE FOR A WIDE RANGE OF CHANGE IN ECCENTRICITY
V. V. Laricheva and M. V. Reyn *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 38–62 refs (See N65-22713 12-30)

A transformation is proposed for the motion equations of a material point in a central gravitational field in the presence of small perturbations to slowly changing variables corresponding to non-Keplerian unperturbed motion. It is demonstrated that such variables are more effective than Keplerian osculating elements for the solution of problems pertaining to the acceleration and deceleration of a point in a force field under the action of small perturbing accelerations. Author

N65-22718 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF INTENSITY AND SPECTRUM OF SOFT ELECTRON FLUX IN THE IONOSPHERE AT ALTITUDES OF 200–500 km
L. A. Antonova *In its* Cosmic Res., Vol. 3, No. 2, 1965 1 Apr. 1965 p 137–160 refs (See N65-22713 12-30)

A method is set forth for reducing the data from the experiment on measurement of electron fluxes at altitudes up to 500 km made with a rocketborne spectrophotometer, and

an interpretation is advanced for the results obtained on the average electron flux intensity values. On the average, the electron flux is $5 \cdot 10^7 cm^{-2} \cdot sec^{-1} \cdot steradian^{-1}$ and carries an energy of ~0.1-0.6 $erg \cdot cm^{-2} \cdot sec^{-1} \cdot steradian^{-1}$. For electrons of ≥ 10 keV, the spectrum is power law with the exponent $\gamma \approx 5.5$. The lower boundary of the spectrum is below 8 keV. Author

N65-22805# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
TROJAN ORBITS. I: D'ALEMBERT SERIES AT L_4 Mathematical Note No. 380
André Deprit and André Delie (Louvain Univ.) Jan. 1965 77 p refs
(DI-82-0393; AD-612265)

The analytical continuation of the family of long period orbits at L_4 represents the normal Cartesian coordinates of the asteroid as d'Alembert series in function of an orbital parameter. By means of a program that enables a computer to calculate symbolically in the real graded algebra of d'Alembert series, the family of Trojan orbits is computed numerically up to the fourteenth order. Within the range of amplitudes of real Trojan planets, the d'Alembert series are in very close agreement with the numerical results of Prof. E. Rabe. Outside this range, the poor convergence of the Fourier series is found to be imputed, not to a 13:1 commensurability between the Trojan's libration period and Jupiter's orbital period, but to the slow convergence of the d'Alembert series all along the family of long period librations. Author

N65-22807# Arizona Univ., Tucson. Dept. of Aerospace Engineering
ORBITAL ALTITUDE FOR MAXIMUM LIFETIME OF A SATELLITE CAPABLE OF SUSTAINED THRUST
Conrad O. Forsythe (M.S. Thesis) 1965 85 p refs
(Contract AF 33(608)-1038)
(AD-612066)

The existence of an optimum altitude for maximum lifetime and the effect of vehicle parameters on this altitude are investigated by varying the parameters within realistic limits and plotting the results on satellite lifetime versus orbital altitude coordinates. Only circular orbits are considered. For a chemical rocket sustaining system, maximum lifetime is achieved when the satellite is placed as high as possible. For an ion propulsion sustaining device, a maximum value of total lifetime results when the satellite is placed in orbit in the neighborhood of 10 nautical miles below the maximum altitude attainable. The maximum value is of the order of only one percent greater than the value of total lifetime that results when the satellite is placed as high as possible. For both sustaining systems, a significant increase in total lifetime at lower altitudes can be achieved. TAB

N65-22840# Aerospace Corp., El Segundo, Calif. Astrodynamics Dept.
DETERMINATION OF VARIATIONS IN THE GRAVITATIONAL FIELD FOR CALCULATION OF ORBIT PERTURBATIONS
William M. Kaula (Calif. Univ., Los Angeles) 31 Jul. 1964 39 p refs
(Contract AF 04(695)-269)
(TDR-269(4922-10)-2; BSD-TDR-64-104; AD-457911)

Determinations of zonal harmonics through J_7 seem firm. Of determinations of tesseral harmonics, those based on camera observation of satellites best satisfy the test of comparison of gravitational and geometric geoid heights, but probably are too small in absolute magnitude. Determinations based on Doppler observations do not suffer from poor distribution of observation, but the poorer geoid comparison and the difficulty in getting a good fit for arcs of several days indicate that they have some distortion and are probably too high in absolute magnitude. Some weighted compromise values are suggested which, for normalized coefficients, have standard deviations around ± 0.3 to 0.4×10^{-6}. The IAU recommendation for GM of $3.98603 \times 10^{14} m^3 sec^2$ is probably correct within $\pm 0.00002 \times 10^{14}$. Author

N65-22866# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER 7
[1965] 32 p

Ten pictures of the Mare Cognitum from the Ranger 7 series of closeup views of the moon are presented. The photos are arranged in order of increasing nearness to the moon, with the final picture taken about 1700 feet above impact. G.G.

N65-22929# RAND Corp., Santa Monica, Calif.
NOTES ON THE BEGINNINGS OF MODERN METEORITICS
Paul M. Sears Jan. 1965 9 p refs
(P-3042; AD-609879)

A report on the development of meteoritics from a medieval to a modern science is presented. Fireballs and shooting stars, 18th century falls and finds, Chladni's theory of a common celestial origin, and meteoritical problems following Chladni are discussed. S.C.W.

N65-22981# McGill Univ., Montreal (Quebec). Space Research Inst.
A PARAMETRIC STUDY OF MULTI-STAGE GUN LAUNCHED ROCKETS
R. M. McKee Mar. 1965 64 p refs Prepared for Can. Com. Corp.
(SRI-HR-2)

In order to assess the potential of multistage gun-launched rockets, a study of the vehicle and trajectory parameters was undertaken. A digital computer program for trajectories was written and was used in an experimental manner to approach optimum performance within various sets of restricting assumptions. The approach was found to be effective, and a useful orbital potential was demonstrated with reasonable design parameters. Author

N65-23029# Congress. House. Committee on Science and Astronautics.
FUTURE PROGRAMS TASK GROUP SUMMARY REPORT
James E. Webb Washington, GPO, 1965 114 p Rept. by NASA to the President U.S. House of Representatives, 89th Congr., 1st Session

The National Aeronautics and Space Administration discusses the results of a special future programs task group review of space objectives in relation both to what has been learned from our space efforts, and to the most important emerging concepts of missions needed for scientific purposes and for advances in technology. Investigated were (1) the capabilities being developed by current programs; (2) intermediate missions which would support national objectives in space and afford steady progress toward longer range goals, while making the most effective use of already developed capabilities; and (3) long-range missions which may comprise space exploration goals for decades ahead. No area of space development was found that requires an overriding emphasis or crash effort. It was concluded that a continued

balanced program of advancement in aeronautics, space sciences, manned space flight, and lunar and planetary exploration represents the best course in the nation's space effort. G.G.

N65-23030# Sperry Gyroscope Co., Ltd., Brentford (England). Engineering Dept.
E.S.R.O. II ENVIRONMENT. CALCULATIONS OF PERTURBING TORQUE
J. J. Weaver Oct. 1964 19 p
(TN-781)

The effect of magnetic torques, gravity gradient torques, aerodynamic torques, and torques produced by radiation pressure and by high velocity meteorites on satellite attitude, orbit attitude, and satellite axes was studied, assuming the following orbit parameters: (1) 350-km perigee; (2) 1100-km apogee; (3) orbit plane normal to sun–earth line; and (4) spin axis (a) parallel to polar axis, and (b) normal to polar axis. Calculations are presented for the magnetic field environment and of perturbing torque in each of these environmental conditions. S.C.W.

N65-23043# Space Technology Labs., Redondo Beach, Calif. STL Technical Library
MANNED MARS MISSIONS: A BIBLIOGRAPHY
L. R. Magnolia and S. A. Gogin, comp. Apr. 1965 152 p refs *Its* Res. Bibliog. No. 53
(STL-9990-6903-KU-000)

This bibliography consists of 348 annotated references dealing with manned Mars flyby and stopover missions, unmanned precursor missions, and Earth-based studies of Mars. The majority of the items are those published from 1955 to January 1965. The abstracts are primarily written by the authors. If an author does not include an abstract with his paper, one is prepared from the text of the report using the author's words; if this is impractical, a brief summary statement or table of contents is provided. Author

N65-23059*# National Aeronautics and Space Administration, Washington, D. C.
A NEW LABORATORY—HOW TO WORK IN IT News Release
Homer E. Newell 29 Apr. 1965 24 p Presented at meeting of the Am. Phys. Soc., Washington, D.C., 29 Apr. 1965 Available from the Scientific and Technical Information Division

Homer E. Newell, Associate Administrator for Space Science and Applications, National Aeronautics and Space Administration, discusses the fundamental part of science in NASA's mission through the extension of numerous scientific disciplines into the domain of space by means of sounding rockets, satellites, and deep space probes. This makes it possible to conduct experiments on the scale of the solar system as opposed to the very much smaller scale of the terrestrial laboratory. Orbiting laboratories will allow experimentation under space conditions such as weightlessness; can serve as gravitational clocks; and might make it possible to measure the relative change in meter due to a distant gravitational disturbance if clocks can be separated by an astronomical unit and then read. It is concluded that it might be easier to study the gravitational force in a cosmic laboratory than on earth. G.G.

N65-23060*# National Aeronautics and Space Administration, Washington, D. C.
[INDUSTRIES' ROLE IN THE NATIONAL SPACE ACTIVITIES]
James E. Webb 11 May 1965 17 p Presented at Washington Board of Trade, Washington, D.C., 11 May 1965 Available from the Scientific and Technical Information Division

James E. Webb, Administrator, National Aeronautics and Space Administration reviews the results of the space program efforts, presents the outlook for future missions, and assesses the impact of the space program on our society. The research and development efforts range from fundamental research in materials, chemistry, and mathematics at one end of the spectrum, to hardware development in propulsion, power sources, structures, and flight dynamics at the other end. G.G.

N65-23109# Washington State Univ., Pullman.
DESIGN OF A CELESTIAL ALTITUDE AND AZIMUTH COMPUTER
Edward Richard Fafara (M.S. Thesis) 1965 46 p refs
(AD-612263)

The celestial altitude and azimuth computer, an electronic analog computer, generates electrical signals which automatically direct a radio antenna to a selected celestial body and cause the antenna to follow the body's motion in the sky. The computer requires input information describing its geographic position, the sidereal position of the selected celestial body, and the relative position of the sidereal coordinate system to the geographic coordinate system. The present design is directed mainly toward sun and star tracking; recommendations have been made to incorporate moon and planet tracking. Author

N65-23147# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory
FURTHER ACCURATE DECLINATIONS OF RADIO SOURCES
J. D. Wyndham and R. B. Read 1964 12 p refs *Its* Observations No. 9
(AD-457727)

The two 90-foot steerable paraboloids were used as a two-element interferometer with a north–south baseline to measure accurately the declinations of 90 radio sources with right ascensions between 9 hours 50 minutes and 24 hours. The antenna separation was 200 feet and the observing frequency was 1390 Mc/s. The average standard error of the measured declinations is ±12 seconds of arc. Author

N65-23155# Aeronutronic, Newport Beach, Calif.
INITIAL ORBIT DETERMINATION FROM LEAST SQUARES REDUCTION OF GEOCENTRIC POSITION VECTORS
T. L. Johnston and T. P. Smith Bedford, Mass., AFSC, Electron. Systems Div., Jan. 1964 47 p refs
(Contract AF 19(628)-562)
(U-2442; ESD-TDR-63-649; AD-429468)

A computer program for initial orbit determination based on a theory employing a linear least squares fit to the geocentric position vectors was developed. Observations can be spread over a number of days since this procedure does not use the times of observations; however, they are used in the differential correction procedure. This program, coded for the Philco 2000, is designed for operational use. Author

N65-23163*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETERMINATION OF TRAJECTORY AND ANGLES OF ATTACK OF A SCOUT HEAT-TRANSFER SPACECRAFT DURING REENTRY FLIGHT IN THE ATMOSPHERE
Robert J. Mayhue Washington, NASA, May 1965 78 p refs
(NASA-TN-D-2776) CFSTI: HC $3.00/MF $0.75

Five-stage Scout reentry spacecraft's large-amplitude motions during the experimental heating data period resulted from disturbances from fourth-stage motor failure. Tracking data were limited to partial optical measurements. To evaluate the heat-transfer data, the spacecraft unknown reentry trajectory and angles of attack were analyzed on the basis of telemetered measurements of the spacecraft linear accelerations and angular velocities. Computational procedures for the analysis employed both flight measurements and aerodynamic characteristics of the spacecraft from preflight wind-tunnel tests. Analysis indicated that the spacecraft entered the heating data period with a velocity of about 22 230 feet per second at an altitude of approximately 308 000 feet—3800 feet per second lower in velocity, and at an altitude 51 000 feet higher than desired as the result of fourth-stage motor failure. The spacecraft maximum angle of attack at the beginning of the heating data period, approximately 40°, damped to about 23° when the nose cap burned off, after which, the resultant angle of attack was reduced further to a maximum of about 6° at maximum dynamic pressure, and indicated that the spacecraft was statically and dynamically stable throughout the experimental heating data period. Author

N65-23181# RAND Corp., Santa Monica, Calif.
SPACE: AN INTERNATIONAL ADVENTURE?
Frederic S. Nyland Dec. 1964 18 p refs
(AD-612199)

A discussion is presented on the uses of artificial satellites, the equipment required for placing vehicles into space, and the manned space flight programs of both the U.S.S.R. and the United States. International political problems which have arisen as a result of space activities are also considered. TAB

N65-23198# Congress. House. Committee on Science and Astronautics.
AUTHORIZING APPROPRIATIONS TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
[1965] 138 p Report No. 273, 89th Congress, 1st Session

N65-23205# System Development Corp., Santa Monica, Calif.
FURTHER REMARKS ON THE RESTRICTED PROBLEM OF THREE BODIES—A NEW PROOF OF A THEOREM OF J. MOSER
Richard B. Barrar 13 Oct. 1964 19 p refs
(SP-1488(001)00; AD-610048)

In this paper it is shown that the results of J. Moser can be readily obtained with the use of Poincaré variables. Moser, dealing with the restricted problem of three bodies, demonstrated the existence of periodic solutions that close after many revolutions and are near periodic solutions of the first kind. Author

N65-23215# Emmanuel Coll., Boston, Mass. Research Language Center
EMISSION SPECTRA OF DISCRETE SOURCES CASSIOPEIA-A, CYGNUS-A, TAURUS-A, VIRGO-A AT 12.5-40 mc FREQUENCIES [SPEKTRY RADIOIZLUCHENIIA DISKRETNYKH ISTOCHIKOV KASSIOPEIA-A, LEBED'-A, TELETS-A, IDEVA-A NA CHASTOTAKH 12, 5-40 MGTS]
L. L. Bazelian et al Bedford, Mass., AFCRL, Jul. 1964 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved., Radiofiz. (Gor'kiy), v. 6, no. 5, 1963 p 897–903
(Contract AF 19(628)-3869)
(E-T-R-64-38; AD-611117)

For four discrete radio sources, results of measuring radiation in a 12.5- to 40-Mc band are given. A characteristic decrease in the spectra of three sources at frequencies below 20 to 25 Mc is noted. The results are used to calculate the characteristic parameters of the sources (emissivity and ratio $H_{\perp}/n_e$) under the assumption that a decrease in the spectrum is caused either by absorption in clouds H_H or by a decrease in the refractive index at the source. Author

N65-23244# Joint Publications Research Service, Washington, D. C.
GOVERNMENT AND PRIVATE AGENCIES CONCERNED WITH SPACE DEVELOPMENT IN JAPAN
12 May 1965 42 p Transl. into ENGLISH from Koku Uchu Nenkan (Tokyo), 30 Jul. 1964 p 91–103
(JPRS-30049; TT-65-30978) CFSTI: $2.00

The Japanese agencies concerned with space development and the organization within each agency is presented. Also, the space development plans of various government agencies for 1964, a 5-year plan for space development by the agency of science and technology, the Tokyo University 1964 observational rocket launching schedule, and budgets of various agencies for space development, 1960 to 1964, are given. Further, the research and development contracts with industry for FY 1963 are tabulated. Additionally, the civilian agencies interested in the space program are included. E.E.B.

N65-23251*# Consultants and Designers, Inc., Arlington, Va.
FRAGMENTATION OF METEOR BODIES [DROBLENIYE METEORNYKH TEL]
V. G. Kruchinenko 27 Apr. 1965 15 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 1, 1965 p 104–112
(Contract NAS5-3760)
(NASA-TT-F-9671; ST-IM-10323)

The photometric analysis of meteors shows anomalously low values of meteor particle density and its decrease along the meteor path. It is shown that these anomalies can be explained by the presence of gradual fragmentation. A factor of meteor fragmentation is obtained as a function of mass. It is shown that the minimum masses of meteor particles, undergoing no further fragmentation, constitute $10^{-4} + 10^{-6}$ g. A distribution function by masses is obtained for meteor bodies, taking into account the fragmentation factor. Author

N65-23256# Stanford Univ., Calif. Radioscience Lab.
RADAR ASTRONOMY AND PROPAGATION RESEARCH Final Report, 1 Dec. 1960–31 Aug. 1964
H. T. Howard, B. B. Lusignan, and V. R. Eshleman Sep. 1964 48 p refs
(Contract AF 19(604)-7436)
(SEL-64-114; AFCRL-65-71; AD-453029)

The core of research centered around the theory and application of radar astronomy techniques for study of the solar corona, interplanetary gas density, ionospheric electron content, and cislunar gas density. Much of the experimental program was made possible by the availability of unique and extensive radar facilities. Author

N65-23300 General Precision, Inc., Little Falls, N. J. Mathematics Dept.
RESEARCH IN THE RESTRICTED PROBLEMS OF THREE AND FOUR BODIES Final Technical Report

Paul B. Richards, Irwin S. Bernstein, Lawrence H. Russell, and Jane Cronin Scanlon Nov. 1964 5 p refs
(Contract AF 49(638)-1325)
(AFOSR-64-2492; AD-609613)

The search for mathematical techniques to answer the questions regarding stability of solutions of the nonlinear equations of motion in the restricted three-body problem led to investigation of works of Kolmogorov, Arnold, and Moser. Arnold's techniques enabled Leontovic to establish the stability of the triangular critical points of the planar restricted three-body problem. This theory can now be applied to the restricted problems of three and four bodies in the investigation of stability properties of known periodic motions. Two studies were conducted in the restricted four-body problem. One dealt with the determination of particular solutions of the linearized equations of motion in the neighborhood of the L_1 libration point of the restricted three-body problem. Periodic, almost periodic, and asymptotically almost periodic trajectories were found. The second study was concerned with the existence of periodic trajectories of the nonlinear equations of motion. The Poincaré method of small parameters was successfully used to establish the existence of periodic trajectories in the neighborhoods of the libration points. These solutions were analytically continued from the critical point solutions of the restricted three-body problem. Author

N65-23326*# Stone (Ralph) and Co., Inc., Los Angeles, Calif.
INVESTIGATIONS OF LUNAR SAMPLING AND SAMPLE RETURN METHODS
E. T. Conrad et al [1965] 66 p refs
(Contract NAS9-3549)
(NASA-CR-65000) CFSTI: HC $3.00/MF $0.75

Return of samples of lunar material acquired by Apollo astronauts implies many unique objectives. Minimum contamination from the packaging system and from outside influences are primary requirements. Configurations studied were generally limited to 8 × 11-1/2 × 19 in. drawer-like outer containers and flexible inner bags of various polyester film and aluminum foil laminates. Results indicated the feasibility of a packaging approach involving partial compartmentation of the sample box and ingress of large and small sample bags through a port in the top. Redundant metallic seals generally met the vacuum requirements, but placed an added burden on the latching mechanism to apply a sufficiently high unit force to effect a positive closure. Limited time available to the astronaut for sampling and restricted container volume place significant constraints on the maximum number of individually packaged samples. To improve payload efficiency and return maximum weight it was found that with the bag configurations tested, samples smaller than 2 in. should be packaged in groups of three or more. Author

N65-23329*# IIT Research Inst., Chicago, Ill. Technology Center
LUNAR AND PLANETARY PROGRAMS ANALYSIS GROUP Letter Report, 16 Nov.–15 Dec. 1963
J. E. Beverly 13 Dec. 1963 4 p
(Contract NASr-65(06))
(NASA-CR-62627; IITRI-W6026-9) CFSTI: HC $1.00/MF $0.50

Work on five astronomical units continued with emphasis on defining any optimum positions in space for a particles-and fields-type mission. A compilation of physical and astronomical data for the comets of prime interest for exploration is in process. Efforts to obtain additional observational data are being made. Further cost comparisons of scientific spacecraft and satellites were made. Differences in the content and cost components of various spacecraft and satellite programs were noted; i.e., spacecraft costs may range from 27% to 74% of total program costs, the remainder being spent on experiments and ground support operations, exclusive of launch vehicle costs. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-22373*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRONIC TEST PROCEDURES FOR THE ENVIRONMENTAL DESIGN QUALIFICATION AND FLIGHT TESTING OF THE UK-2/S-52
Harry W. Leverone and Nathan Mandell 15 Feb. 1963 146 p
(NASA-TM-X-55210; X-324-63-113) CFSTI: HC $4.00/MF $1.00

The object of the UK-2/S-52 spacecraft is to collect data and transmit that data back to earth. A close-knit electronics organization, with a thorough knowledge of the spacecraft and the equipment utilized in testing the spacecraft, is essential to a successful conclusion of the project. A test team, in conjunction with experimenters and designers, examined the performance of the spacecraft electronics for deviations in any mode of operation under environmental exposure, to collect data for verification of performance characteristics under test, and to intelligently apply this information to benefit this and subsequent projects. Author

N65-22478# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
ROCKETSONDE TECHNIQUES FOR THE MEASUREMENT OF TEMPERATURE AND WIND IN THE STRATOSPHERE
Harold N. Ballard Feb. 1965 117 p refs
(ERDA-269; AD-458308)

The upper atmosphere rocket sounding system is in operation at White Sands Missile Range, New Mexico, and is representative of the systems in operation at 22 other locations which serve as Meteorological Rocket Network stations. Basic system components and the theory of operation are discussed. The various facilities and operational procedures described may serve as a guide to any group which plans to use such a system for obtaining measurements of stratospheric temperature and wind. Author

N65-22480# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
A THEORETICAL AND PRACTICAL STUDY OF AEROBEE-150 BALLISTICS
Michael D'Arcy Mar. 1965 31 p refs
(ERDA-278; AD-458317)

Tables and graphs representing theoretical range, peak altitude, burnout velocity and altitude, tower tilt effect, coriolis displacement and unit wind effect for the Aerobee-150 are presented. A comparison of the theoretical and actual performance of rockets showed no significant differences between the Daw and Walter ballistic models. Author

N65-22543*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN MONTHLY PROGRESS REPORT (JANUARY 16, 1964–FEBRUARY 16, 1964)
29 Feb. 1964 22 p
(NASA-TM-X-56339; MPR-SAT-64-2) CFSTI: HC $1.00/MF $0.50

On January 29, 1964, SA-5, the first Saturn to carry a live second stage, was successfully launched from Cape Kennedy, following an unsuccessful launch attempt on January 27. At Santa Monica S-IV-7 checkout was completed, and the stage shipped for static test operations. On January 24, the S-IV All-Systems stage was destroyed and test stand damaged when the oxidizer tank ruptured as the result of overpressurization. At Santa Monica, the S-IVB/IB-1 common bulkhead aft dome except for the dollar weld was completed. The S-IVB structural test stage LH_2 forward dome was replaced by the dome fabricated for the dynamics test stage because of a questionable weld repair. At Santa Monica, the All-Systems test stage common bulkhead was completed. On Febraury 8, hydrostatic testing of the S-IC test fuel tank was concluded successfully. The first S-II all-welded bulkhead, with the welding of the dollar section in place was made. Author

N65-22553*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN MONTHLY PROGRESS REPORT, AUGUST 15–SEPTEMBER 18, 1963
Oswald H. Lange 20 Sep. 1963 22 p
(NASA-TM-X-56316; MPR-SAT-63-12) CFSTI: HC $1.00/MF $0.50

Research and development progress in the Saturn I, IB, and V vehicle programs is presented. The status of the Saturn engine programs is not included. Saturn I configuration developments include arrival of S-I-5, S-IU-5 and payload and S-IV-5 at the Atlantic Missile Range; dynamic testing of SA-D6; and a successful propellant loading test of the S-IV A11 Systems vehicle. Saturn IB configuration developments include modification of the S-IVB/IB contract, and completion of the S-IVB Battleship tank hydrostatic tests and tank calibration. Saturn V configuration developments include completion of the S-IC test fuel tank lower cylindrical skin section and all meridian welds on the lower bulkhead; completion of the first meridian weld on S-II; delay of the first S-II Battleship hot firing; and award of a contract for design and development of a Saturn V guidance computer. M.P.G.

N65-22554*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN IB MISSION PLAN AND TECHNICAL INFORMATION CHECK LIST, VOLUME II
1 Mar. 1964 78 p Revision I
(NASA-TM-X-56315) CFSTI: HC $3.00/MF $0.50

This information covers the Saturn IB, its S-IB stage, S-IVB stage, and instrument unit. The launch vehicle and payload data, launch vehicle configuration, flight test objectives, and flight test measuring programs for each flight vehicle are presented. The major components and subassemblies of each of the three assemblies are listed in checklist form, including the component and subassembly drawing numbers effective for specific launch vehicles. G.G.

N65-22560*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN IB MISSION PLAN AND TECHNICAL INFORMATION CHECKLIST, VOLUME II
John O. Aberg 1 Sep. 1964 81 p Revision 3
(NASA-TM-X-56340) CFSTI: HC $2.00/MF $0.75

Technical information relative to the Saturn IB configuration, test objectives, measuring program, and payload is presented. The S-IB Stage, S-IVB Stage, and Saturn IB instrument unit are discussed and the major components and subassemblies of each are listed. Component and subassembly drawing numbers effective for specific launch vehicles are included, and the effectivity of an item to a specific flight vehicle indicated. Test objectives to be accomplished by the complete Saturn IB launch vehicle, its two stages and instrument unit are described. Test objective items peculiar to a specific launch vehicle mission are indicated under appropriate vehicle number. Information pertaining to the measuring program is divided into three areas of coverage: S-IB stage, S-IVB stage, and instrument unit. The parameters to be measured and the number of measurements for a particular mission are tabulated. Illustrations of several profiles of the Saturn IB configuration are included. S.C.W.

N65-22564*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN MONTHLY PROGRESS REPORT, DECEMBER 16, 1963–JANUARY 16, 1964
Lee B. James and Arthur Rudolph 5 Feb. 1964 19 p
(NASA-TM-X-56338; MPR-SAT-64-1) CFSTI: HC $1.00/MF $0.50

As a result of studies on the SA-5 stress corrosion problem, critical tubing assemblies were replaced in the SA-5 booster, and the stage is now considered flightworthy. Checkout of S-I-8 and assembly of S-I-10 continued. Structural assembly of the S-IC test fuel tank half intertank was completed. The lower fuel bulkhead-to-LOX tunnel extension weld and upper fuel bulkhead polar gap weld were rejected and the components removed; test welding programs were begun to resolve the welding problems. Meridian welding of the S-II Structural Test Stage aft common bulkhead was completed. For a scheduled 36-second mainstage duration, the fifth test with F-1 Engine F-1001 was conducted. The F-1 Engine Test Stand superstructure erection continued satisfactorily, with about 95% of the steel in place. Author

N65-22613# Advisory Group for Aeronautical Research and Development, Paris (France).
A SURVEY OF THE EFFECTS OF ELASTICITY ON THE CONTROL OF LARGE BOOSTER ROCKETS AND THE POSSIBLE ADVANTAGES OF USING ADAPTIVE SERVO TECHNIQUES
K. W. Smith (RAE, Farnborough) Jun. 1964 22 p refs
(AGARD-481)

The problems of control system stability in the presence of flexibility are reviewed in physical principles. It is shown that with present-day large boosters it is possible to stabilize the loop by conventional means, but that the resulting stability margins are small. To compensate for possible variations in critical parameters it is suggested that certain control functions are made self-adaptive. No general solutions are thought to be possible, but possible solutions are suggested for typical cases of marginal stability. Author

N65-22735 Army Satellite Communications Agency, Fort Monmouth, N. J.
ARMY PARTICIPATION IN PROJECT SYNCOM
J. Wilson Johnston *In* Army Dept. Army Sci. Conf. Proc., Vol. I (1964) p 23–43 (See N65-22732 12-34)

The SYNCOM-SATCOM network in which communications satellites provide instantaneous relay of messages between intercontinental ground stations is described, and the results of a communications test are given. The SYNCOM spacecraft

is a synchronous altitude satellite 28 inches in diameter and it weighs 85 pounds in orbit. The support complex consists of fixed terminals at Fort Dix in New Jersey, Camp Roberts in California, several transportable terminals, and one seaborne terminal aboard a U.S. Navy transport. Photographs of these terminals are shown. Satellite communication capability, 24-hour satellite earth orbital path, and the orbit configuration, are depicted. Results of a communications test using a single nominal 4-kilocycle voice channel are reported; a chart shows maximum and minimum signal levels over a 24-hour period, and the ratio of signal-plus-noise to noise for the 4-kilocycle baseband mode that offered best performance. In a special test, human psychological adjustment to 0.6-second round-trip delay with the echo suppressed was demonstrated in a test with 1000 participants. J.M.D.

N65-22781# National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
PAYLOAD PREPARATION FOR RESEARCH ROCKETS
Jul. 1964 79 p refs
(ERB-680)

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N65-22782 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
ENGINEERING ASSISTANCE TO THE HIGH-ALTITUDE ROCKET-SOUNDING PROGRAM
W. L. Haney *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 1–4 From Bull. of Radio and Elec. Eng. Div., v. 11, no. 2, Jul. 1961 (See N65-22781 12-31)

The central engineering role of the Radio and Electrical Engineering Division in Canada's nondefense space research activities is described. In general, this group is responsible for the technical coordination of the rocket-sounding program, coordination of vehicle payload, and provision of instrumentation not directly part of an experiment. In particular, this group provides standard electronic systems, such as rocket beacons for position-fixing by ground radar and a telemetry package under development. The Division's model testing facility is being used in measuring the characteristics and radiation pattern of the antenna system for the telemetry package. Also in progress are cooperative studies in the design of quadraloop antennas for the Black Brant III high-altitude research rocket. Black Brant II will still be used for experiments in the near future. The final assembly of experiments, environmental testing, and initial checkout is made jointly by the experimenters and the Divisional engineering group. M.P.G.

N65-22789 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
BLACK BRANT ROCKETS FIRED APRIL 5–6, 1963
J. H. Craven *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 37–42 refs From Bull. of Radio and Elec. Eng. Div., v. 13, no. 2, Jun. 1963 (See N65-22781 12-31)

The functioning of the scientific payloads of two Black Brant rockets fired into an aurora over Fort Churchill, Manitoba on the night of April 5–6, 1963 is discussed. The first rocket fired carried cosmic-ray detectors, Langmuir plasma probes, microphone micrometeoroid detectors, and a potential gradient package which was ejected at the desired time. The second rocket carried three electron density packages which were all ejected at the correct times, a planar Langmuir probe, a magnetometer designed to measure the fine component of the earth's magnetic field, and a photometer to measure the light of the aurora. Data from these experiments are still being analyzed. M.P.G.

N65-22791 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
JANUARY 1964 ROCKET FIRINGS
S. G. Jones *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 49–52 From Bull. of Radio and Elec. Eng. Div., v. 13, no. 4, Dec. 1963 (See N65-22781 12-31)

Three payloads of scientific instrumentation were prepared for launching in Black Brant II sounding rockets to study upper atmosphere phenomena, especially those associated with visual aurora formation. The scientific experiments included in the payload of each rocket, and a preliminary assessment of each flight are tabulated. Vehicle performance of the flights launched on the nights of Jan. 8 and 14, 1964 was not normal and apogee altitudes were lower than expected. The flight launched on Jan. 17, 1964 reached a record altitude of about 155 km, performance was normal, and most of the scientific experiments appear to have operated satisfactorily. Detailed results of the scientific and engineering measurements will be published as data analyses are completed. M.P.G.

N65-22792 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
ENGINEERING DATA FROM JANUARY 1964 ROCKET LAUNCHINGS
S. G. Jones *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 53–60 From Bull. of Radio and Elec. Eng. Div., v. 14, no. 1, Mar. 1964 (See N65-22781 12-31)

Analyses of engineering data on the three January 1964 Black Brant II sounding rocket launches are discussed, including rocket trajectories and motions, temperature measurements, payload vibration and accelerations, telemetry systems performance, and performance of auxiliary devices. Vehicle

malfunction in two of the three rockets was disappointing not only because of payload failures but also because the scientific value of the data obtained was less because of the low altitudes attained. However, considerable portions of the payload withstood the adverse conditions, and some useful scientific data were obtained from each of the rockets with abnormal vehicle performance. The vehicle performance of the third rocket was normal, good scientific data were obtained, and payload performance was very satisfactory. M.P.G.

N65-22793 National Research Council of Canada, Ottawa (Ontario). Radio and Electrical Engineering Div.
FOUR SOUNDING ROCKETS FIRED AT FORT CHURCHILL APRIL 1964
A. Staniforth *In its* Payload Prepn. for Res. Rockets Jul. 1964 p 61–71 From Bull. of Radio and Elec. Eng. Div., v. 14, no. 2, Jun. 1964 (See N65-22781 12-31)

A preliminary report of the four Black Brant II sounding rocket firings in April 1964 is presented. Three rockets were standard vehicles, and the fourth had a Black Brant V nose cone and fin assembly. The experiments included in the payload of each rocket are tabulated, and a summary of the results of each flight is given. In spite of launching from outside launchers in 0° weather, all flights were satisfactory. M.P.G.

N65-22843# Czechoslovak Academy of Sciences, Ondrejov.
SURVEY OF EXPLORATORY EARTH SATELLITES AND INTERPLANETARY PROBES, THEIR EQUIPMENT AND DATA GATHERING [PREHLED VYZKUMNYCH DRUZIC A MEZIPLANETARNICH SOND, JEJICH VYBAVENI A PROVADENYCH MERENI]
Peter Lala and Jan Vlachy [1965] 102 p In CZECHOSLOVAKIAN *Its* Czech. J. Phys., Vol. A 15, 1965

Charts giving orbital data and the characteristics of the experimental equipment carried on the various exploratory satellites of the world are presented. The satellites are also tabulated according to their main purpose (meteorology, communications, magnetic field and micrometeorite measurements, ionospheric research, etc.). Configurations and photographs of selected satellites are included. M.P.G.

N65-22846*# National Aeronautics and Space Administration. Washington, D. C.
APOLLO BOILERPLATE 22. NASA TO TEST APOLLO ESCAPE SYSTEM AT HIGH ALTITUDE
9 May 1965 17 p
(NASA News Release-65-145) Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration announced plans for launching the Apollo Boilerplate spacecraft to test the escape subsystem at an altitude of about 175000 feet. The main objectives of this test are (1) to determine the performance of the launch escape vehicle at an altitude approximating the upper limit of the canard subsystem, and (2) to demonstrate orientation of the launch escape vehicle to a relatively stable position with the main heat shield forward for deployment of the dual parachutes. A flight plan and the test vehicle components and characteristics are also discussed. G.G.

N65-22883# Elliot Bros., Ltd., London (England).
ELECTRONIC ASPECTS OF SPACE TRANSPORTER
P. O. Hawkins [1964] 8 p Presented at Eurospace Conf., Brussels, 24–25 Jan. 1964

The use of microcircuits and integral redundancy to obtain and insure reliability of electronic equipment for the onboard navigational system of a space transporter is discussed. The present limited frequency responses of micropower circuits to 1 megacycle are adequate for most electronic flight control circuits but not fast enough for real-time computer logic circuits. The use of tunnel diodes as logic elements for high speed computers reduces the quantity of basic electronics, lowers power consumption, and induces greater reliability. Reliable fail-safe and failure-free electronics are of importance in the automatic navigation and flight control for the launching and reentry phase of the space transporter, because the speed and complexity involved exclude pilot control. G.G.

N65-23160*# National Aeronautics and Space Administration. Goodard Space Flight Center, Greenbelt, Md.
FLIGHT PERFORMANCE DATA FROM THE SCOUT X-258 ROCKET MOTOR
James A. Nagy Washington, NASA, May 1965 41 p refs
(NASA-TN-D-2756) CFSTI: HC $3.00/MF $0.50

Nine channels of performance data were obtained during flight of the Scout launch vehicle (S-122). Shock and vibration data were obtained from the forward motor shoulder of the fourth stage X-258 from liftoff through fourth-stage motor burnout. Low-level random vibrations recorded during first-stage burning and first-stage motor burning irregularities which caused increases in vibration level at the payload are analyzed, as well as transients recorded during first- and third-stage burning. Lack of appreciable vibrations during fourth-stage burning correlates with results of a simulated high-altitude static firing of an X-258. There was no indication of X-258 chuffing; however, the tailoff was long. Low-frequency accelerometers measured lateral bending frequencies and low-frequency vehicle pitching and yawing motions during the first three stages. Spin rate and gyroscopic motions during fourth-stage burning were recorded, as well as axial steady-state acceleration for all stages. The experiment measured X-258 headcap pressure. The X-258 forward dome temperature is presented for the first 2 hours after fourth-stage ignition. Author

N65-23177# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Dynamic Analysis Section
FREE NONLINEAR DYNAMICS OF A ROTATING FLEXIBLY-CONNECTED DOUBLE-MASS SPACE STATION
Fred Austin Jan. 1965 48 p refs
(ADR-06-15-64.1)

Exact solutions to the dynamic equations for a free rotating flexibly connected double-mass system were investigated to ascertain the nonlinear effects on the system dynamics. Results are expressed in terms of the canonical forms of elliptic integrals. Numerical results illustrate the radial vibration waveform and the frequency variation with rotational speed. The nonlinear effects become pronounced in systems where the ratio of the rotational speed to nonrotating flexible-body frequency is high; however for practical space-station applications the character of the results can be closely predicted by the application of linearized solutions for oscillations as high as 10% of the radius. Author

N65-23287*# National Aeronautics and Space Administration. Washington, D. C.
INSTRUMENTS OF SPACE
G. A. Vacca [1964] 31 p Presented to the Instr. Soc. of Am., Boston, 2 Nov. 1964
(NASA-TM-X-56387) CFSTI: HC $2.00/MF $0.50

Some of the major instrument systems for measuring and acquiring engineering, scientific, and medical data in the fields

of aeronautics, atmospheric satellites, lunar exploration, orbiting solar observatories, and the manned exploration of space, were briefly described by G. A. Vacca, National Aeronautics and Space Administration. Among the general instrumentation needs and requirements are an extension of range measurements, more accurate measurement ability, combinations of measurements to reduce the overall number of measurements, better standards and calibration methods, and particularly absolute methods of calibration. A table presents the typical instrumentation for space stations grouped by *Spacecraft Integrity, Biomedical Surveillance, Scientific Observation,* and *Calibration and Standards.* G.G.

N65-23324# Dassault (Marcel) Aeronautique-Electronique, Vaucresson, Seine-et-Oise (France).
ABOUT A CONCEPT OF AN AEROSPACE TRANSPORTER
H. Deplante and P. Perrier 5 Feb. 1964 10 p Presented at The Journees Techniques EUROSPACE, 23–24 Jan. 1964

The results of a survey on composite planes consisting of a large delta wing vehicle with horizontal takeoff and containing a partially submerged long cigar-shaped vehicle in its belly are presented. Considered were a minimum transferable load of 2240 lbs to be delivered to a station, a rendezvous station at a maximum altitude of 200 miles, and maximal changes of the orbiting plane of −5° for a rendezvous at 200 miles, and of −7° for a rendezvous at 100 miles. It was concluded that cryogenic propellants such as $LH^2 + LO^2$ are feasible for the orbital motor. Turborocket motors can be used for first stage airbreathing motors, and lift engines or variable geometry are useful for the final approach and landing. A composite plane made up of a large delta wing and containing a long cigar shaped vehicle with very narrow wings that offers total recuperation and permits the delivery and assembly of space station components at a certain rendezvous was found most feasible. G.G.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-22339# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics
THEORETICAL ANALYSIS OF INTERNAL BLAST WAVES IN SPHERES Quarterly Progress Report, 1 Jul.–30 Sep. 1964
Norman Davids 30 Sep. 1964 4 p
(Contract DA-36-034-ORD-3576-RD)
(QPR-11)

A theoretical study on the propagation of waves produced by an explosion in a spherical cavity in a metal is reported. Research on computer analysis of dynamical problems in spherical elastic waves, plastic rigid spherical waves, elastic plastic spherical waves, and shock and detonation waves is discussed. Data on plastic spheres are also presented. S.C.W.

N65-22363*# ARA, Inc., West Covina, Calif.
CONICAL SHELL VIBRATIONS
Daniel H. Platus Washington, NASA, Apr. 1965 50 p refs Prepared for Aerojet-General Corp., Azusa, Calif.
(Contract NASr-111)
(NASA-TN-D-2767) CFSTI: HC $2.00/MF $0.50

An analytical method is presented for predicting the natural vibration frequencies and mode shapes of thin-walled conical shells rigidly fixed at one end and free at the other. Both extensional and inextensional theories are examined separately and a simplifying approximation is introduced for combining the results for the general case. The extensional theory is treated by using a Rayleigh–Ritz procedure with assumed mode shapes in the form of polynomial expressions in the axial shell coordinate, selected to satisfy the fixed-end displacement conditions. The natural frequencies and mode shapes are computed by using an IBM 7090 machine program developed for the extensional case. Results obtained by the approximate method show good agreement with experimental values obtained from actual vibration tests of thin-walled conical shells. Author

N65-22369*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARAMETRIC INVESTIGATION OF LIQUID HYDROGEN TANK PRESSURIZATION DURING OUTFLOW
David A. Mandell and William H. Roudebush Washington, NASA, Apr. 1965 30 p refs
(NASA-TN-D-2797) CFSTI: HC $2.00/MF $0.50

The factors influencing the amount of gas required to pressurize a cylindrical tank of liquid hydrogen during outflow are investigated analytically based on a simplified model of the tank-flow and heat-transfer problem. The investigation begins with an established set of differential equations describing the problem. These equations and associated initial and boundary conditions are put in terms of dimensionless variables. The ratio of the mass of gas required for pressurization to a standard mass is shown to depend on only a few parameters. By computer solution of the equations over a wide range of values of the parameters it is found that only two are of principal importance. These two dimensionless parameters have the form of modified Stanton numbers, one associated with the gas and one with the tank wall. A figure is presented from which the pressurant mass ratio can be found for a wide range of values of the modified gas and wall Stanton numbers. A comparison with experimental results is made. Author

N65-22374 Illinois Univ., Urbana. Engineering Experiment Station
ELASTIC PLATES: ANNOTATED BIBLIOGRAPHY, 1930–1962
George E. Sliter, Robert J. Nikolai, and Arthur P. Boresi Oct. 1964 230 p refs
(Grants NSF G-14647; NSF GP-903)
(TR-10) Available from Eng. Publ. Office: $1.00

This set of references on plate theory considers the general problem of bending of elastic plates. Over 85% of the 994 English language papers reviewed were annotated. In cases where critical reviews of papers are available, *The Applied Mechanics Review* reference number is appended to the entry. The bibliography does not include, in most cases, problems in the following categories: (a) plane problems of elasticity, (b) plastic, elastoplastic, and viscoelastic behavior of plates, (c) aerodynamic problems of panel flutter, (d) buckling of plate webs, (e) corrugated plates, and (f) experimental methods. The papers are classified topically and, in each category, papers are listed alphabetically by author. Author

N65-22377# Huyck Research Center, Stamford, Conn.
THEORETICAL ANALYSIS OF THE EFFECT OF IMPULSIVE LOADS ON SIMPLY SUPPORTED BEAMS

E. L. Victory Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jan. 1965 107 p refs
(Contract AF 33(657)-11697)
(HRC-021-1; AFFDL-TR-64-177; AD-457510)

A simplified method is developed for the analysis of the large plastic deformation of simply supported beams under impulsive loading. The analysis involves the derivation of an "Effective Stiffness Term EI" which represents the variation in the rigidity of the beam as it is plastically deformed. Application of this analysis to experimental data yielded good correlation between theory and experiment. An attempt was also made to use a new delay time analysis to provide a simplified solution. The results indicated that this method was not applicable to this type of beam problem in view of the present state of the art. Author

N65-22410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL MECHANICS OF THE AIRPLANE
A. A. Umanskiy 15 Mar. 1965 777 p refs Transl. into ENGLISH of the book "Stroitel'naya Mekhanika Samoleta" Moscow, Gos. Nauchno-Tekhn. Izd. Oborongiz, 1961 p 3–529
(FTD-TT-63-274/1+2; AD-612618)

The volume is a study aid for the aviation high schools on the subject "structural mechanics of the airplane" which contains the fundamental theoretical basis for the static calculations set forth in the course "strength calculations for the airplane." The book sets forth the problems of complex beam bending, strength and stability of plates and shells, strength and bearing ability calculations for structures of the wing and fuselage type, calculations for flat and three-dimensional girders, and a number of auxiliary problems with the appropriate mathematical apparatus. The book reflects the contemporary level of theoretical knowledge in the field of the structural mechanics of aviation structures, and may be employed by engineers in the industry in their practical work. TAB

N65-22439# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW TYPES OF ALL-METAL ELASTIC-DAMPING ELEMENTS, THEIR PREPARATION AND APPLICATION
A. M. Soyfer and V. N. Buzitskiy 24 Mar. 1965 13 p Transl. into ENGLISH from Rasseyaniye Energii Pri Kolebaniyakh Uprugikh Sistem (USSR), 1963 p 269–275
(FTD-TT-64-1033/1+2; AD-613452)

The damping elements are made of MR (metallic rubber) the structural basis of which is a spatial lattice of thin metallic spiral, similar to rubber macromolecules. Made in form of a special elastic-damping elements (washer, bushing, membrane, plate, etc.), the MR material can be used in joining and contact places of details and units of machines for dampening mechanical oscillations, and also in the suspension of aggregates, devices and mechanisms for absorption of shock. TAB

N65-22514# Army Materials Research Agency, Watertown, Mass.
NATURAL FREQUENCIES AND MODE SHAPES FOR AXISYMMETRIC VIBRATION OF DEEP SPHERICAL CAPS
Edward W. Ross, Jr. Nov. 1964 37 p refs
(AMRA-TR-64-8; AD-457109)

This paper contains the results of an approximate analysis of the axially symmetric vibrations of deep spherical elastic shells. The approximation is based on the asymptotic formulas for Legendre functions of large degree. The results are relatively simple approximate formulas for the natural frequencies and mode shapes under a variety of boundary conditions at the shell edge. The results agree very well with values obtained by Kalnins, using numerical methods. Author

N65-22610# Advisory Group for Aeronautical Research and Development, Paris (France).
THE PREPARATION OF REPORTS ON FATIGUE OF STRUCTURES AND MATERIALS
W. Barrois and Franz Bollenrath Jul. 1964 23 p ref
(AGARD-477)

This report was prepared for the AGARD Structures and Materials Panel and is aimed at the standardization of fatigue test reports so as to make them more easily readable and usable by the reader for other purposes. The first part on the data required for the general use of test results, is a formal panel recommendation, while the second and third parts, on terminology and abbreviated symbols for fatigue loads, are examples of concepts that should be clearly defined to avoid misunderstanding, although not formal panel recommendations. The fourth part lists the factors affecting the resistance of a material under test. Author

N65-22611# Advisory Group for Aeronautical Research and Development, Paris (France).
USE OF DYNAMIC MODELS IN LAUNCH-VEHICLE DEVELOPMENT
H. L. Runyan, H. G. Morgan, and J. S. Mixson (NASA. Langley Res. Center) May 1964 46 p refs
(AGARD-479)

The role of reduced scale models in the solution of the structural dynamic problems of large launch vehicles is discussed. A general discussion of scaling principles is given followed by tabulation of the specific parameters for scaling of bending, longitudinal, and local vibrations; liquid sloshing; combined elastic–aerodynamic buffet; flutter; and ground wind phenomenon. Three examples of the use of models are presented illustrating the utility of reduced scale models. Author

N65-22625*# Consultants and Designers, Inc., Arlington, Va.
LOSS OF STABILITY BY ROTATIONAL SHELLS IN TORSION [POTERYA USTOYCHIVOSTI OBOLOCHEK VRASHCHENIYA PRI KRUCHENII]
A. V. Pogorelov 3 May 1965 5 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 6, 1965 p 1283–1284
(Contract NAS5-3760)
(NASA-TT-F-9673; ST-TE-10322) CFSTI: HC $1.00/MF $0.50

This paper deals with the problem of determining the critical value of the moment M, created by uniformly distributed tangential forces along the edge of a convex shell of rotation, which lead to stability loss. Author

N65-22646 Joint Publications Research Service, Washington, D. C.
NON-LINEAR STABILITY PROBLEM OF ROUND BOTTOM THIN SPHERICAL SHELLS. I: THE NON-LINEAR STABILITY PROBLEM OF A ROUND BOTTOM THIN SPHERICAL SHELL UNDER A SYMMETRICAL LINEAR LOAD
K'ai-yuan Yeh, Jen-huai Liu, Ch'ing-yuan P'ing, and Szu-lai Li *In its* Transl. on Communist China's Sci. and Technol., No. 170 14 Apr. 1965 p 13–20 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 2, 1965 p 142–145
(See N65-22645 12-34) CFSTI: $3.00

Algorithms are derived for the problem of nonlinear stability of a round bottom thin spherical shell subjected to symmetrical linear load; addition of a simple edge support and a movable clamping of the edge are considered. The procedure involves simplifying the intractable nonlinear stability equations by removal of negligible terms, and by introduction of dimensionless quantities, which reduce the problem to that of a linear boundary value problem. Solutions for the parameters are presented for the case of simple edge support, and for movable clamping of the edge. Stability curves are shown for linear and concentration loads for the lower edge simple support. Agreement between calculated and experimental values is said to be better than for an earlier method. J.M.D.

N65-22647 Joint Publications Research Service, Washington, D. C.
NON-LINEAR STABILITY PROBLEM OF ROUND BOTTOM THIN SPHERICAL SHELLS. II: THE NON-LINEAR STABILITY PROBLEM OF A ROUND BOTTOM THIN SPHERICAL SHELL UNDER EDGE TORQUE
K'ai-yuan Yeh, Jen-huai Liu, Ch'uan-chih Chang, and I-fan Hsu *In its* Transl. on Communist China's Sci. and Technol., No. 170 14 Apr. 1965 p 21–26 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 2, 1965 p 145–147 (See N65-22645 12-34) CFSTI: $3.00

For the nonlinear stability problem of a round bottom thin spherical shell subjected to edge torque, algorithms are derived for stability parameters. Through use of a substitution method, dimensionless quantities are introduced which reduce the nonlinear problem to that of a linear boundary value problem. First, second, and third approximations are developed in arriving at stability equations. A stability curve is shown for comparison of second and third approximations and an earlier method for stability computations. The relative errors of the second and third approximations for boundary torque solutions are evaluated; it is concluded that the third approximation is good enough for the specified range of parameter values. J.M.D.

N65-22664# Martin Co., Baltimore, Md.
FLEXURE OF PARALLEL-STIFFENED PLATES
Norris J. Huffington, Jr. and Robert N. Schumacher Jan. 1965 81 p refs
(RR-59)

Previous work concerning the theoretical prediction of the effective flexural rigidities of stiffened plates (treated as orthotropic plates) is summarized and new relations for the analysis of stresses and strains are introduced. The complete theory, which is not restricted to plates stiffened symmetrically with respect to the plate midplane, is then applied to certain static and dynamic boundary value problems and the predictions are compared with extensive experimental data, mainly in the form of strain measurements. The vibration analysis includes the effects of rotatory inertias of stiffeners and plate and the effect of nonuniformly distributed stiffener masses. The results are presented as simple formulas from which the natural frequencies of stiffened plates can be easily determined for many boundary condition combinations. The theoretical values of both frequencies and strains are in satisfactory agreement with experimental results. Author

N65-22670# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering
INVESTIGATION OF AUTOMATED DIRECT DESIGN OF STEEL RIGID PLANAR FRAMES
Roger Adams Hadley (Ph.D. Thesis) 1965 171 p refs
(Contract Nonr-4102(01))
(AD-612282)

A rational design process for a rigid, planar frame consists of two parts. Phase A determines optimum design just for individual members (suboptimization); phase B determines the same for the entire structure. An automated design program written with controls to permit designs by the rational existing stress analysis system. These controls allow designs satisfying the criteria of (1) minimum weight within the constraint of allowable stresses and full column stiffness and (2) minimum weight allowing reduced column stiffness with axial load. Two rigid frames were designed using this program. The designs were optimized using the sensitivities of change in volume due to change in moment, and due to change in cross section. Designs which resulted from satisfying criterion (1) are of greater volume than those obtained by satisfying criterion (2). The absolute minimum occurs in the range of zero moment interaction between the beams and columns, for spans up to 36 feet, suggesting the simple general criterion of zero moment interaction for suboptimization, and a minimum number of operations for overall optimizations, throughout the normal range of building spans. Author

N65-22684# Martin Co., Baltimore, Md. Research Dept.
BENDING ATHWART A PARALLEL-STIFFENED PLATE
Norris J. Huffington, Jr., Robert N. Schumacher, and Ruth L. Irwin Dec. 1964 54 p refs
(RR-53)

Consideration is given to the problem of predicting the flexural rigidity of plates reinforced by parallel, equally spaced stiffeners for the direction (in the plane of the plate) normal to the stiffener orientation, and also the stresses induced by a bending moment acting in this direction. The determination of this lateral flexural rigidity is formulated in terms of a problem in plane elasticity which may be solved by the finite difference method for specific cases. Results obtained by this method are compared with those obtained by a simpler approximate procedure. An explicit relation is derived for the flexural rigidity associated with Poisson contraction. Experimental results are introduced and compared with theoretical predictions. Author

N65-22775# Technical Operations Research, Burlington, Mass.
EFFECTS OF HYPERVELOCITY IMPACTS ON MATERIALS Technical Report, 1 Feb.–30 Oct. 1964
R. W. O'Neil, S. Holland, T. Holland, V. E. Scherrer, and H. Stevens Jan. 1965 98 p ref
(Contract AF 33(615)-1333)
(AFML-TR-65-14; AD-610864)

The exploding-foil hypervelocity particle-acceleration technique is described. The dependence of the technique on specific geometrical factors in the gun and on discharge characteristics of the electrical storage system is reported. A semiquantitative theory for predicting the magnitude and time dependence of the most significant operative mechanisms was conceived for the exploding-foil gun. The program was divided into two phases. In the first phase of the work techniques were devised to measure accurately the parameters affecting particle acceleration. The second phase investigated the performance of a standardized gun model chosen for this study as a function of stored electrical energy and of actual input power. Good correlation was found to exist between particle velocity and power input rate. Preliminary measurements were made on the impacting mass at several energies in the experimental series. The feasibility of accelerating spherical particles with exploding-conductor technique was discussed. Author

N65-22880# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGNING MINIMUM-WEIGHT SHELLS
F. G. Shamiyev 8 Feb. 1965 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk, no. 5, 1963 p 37–41
(FTD-TT-64-953/1+2; AD-611533)

The condition of yield for the maximum tangential stress and the maximum applied stress can be used for obtaining the lower and upper estimates of the limiting loads on plates and shells. In the present work the condition of yield of the maximum applied stress is used for obtaining the lower limit in the problem of designing cylindrical shells of minimum weight. The upper limit for the given problem has been obtained. TAB

N65-22882# Engineering Research Associates, Toronto (Ontario).
STUDIES OF THE NOSE SHAPE OF HYDROFOIL PROFILES WHICH HAVE A WIDE NON-CAVITATING INCIDENCE RANGE
J. R. Richardson Mar. 1965 27 p refs
(Contract NObs-90084)
(ERA-53-2)

Profiles have been designed for operating in a seaway by relaxing the optimum conditions at the design lift coefficient in order to obtain as wide an incidence range as possible. The leading edges of these sections appeared to be sharp, but were not defined accurately by the theory. Studies have been restricted to uncambered sections with fore-and-aft symmetry. It is shown that exact linear theory leads to a negative thickness at the nose, which is of course, physically impossible. However, a finite nose radius results when nonlinear theory is used in the analysis of the leading edge region. The resultant thin profiles have a much greater incidence range than thin conventional foil sections. Author

N65-22885# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
THE EFFECT OF INITIAL IMPERFECTIONS ON THE COLLAPSE STRENGTH OF DEEP SPHERICAL SHELLS
Martin A. Krenzke and Thomas J. Kiernan Feb. 1965 38 p refs
(DTMB-1757; AD-612100)

An analysis is developed to account for the effects of imperfections on the collapse strength of spherical shells. The analysis is empirical but is based on an engineering evaluation of recent tests of near-perfect deep spherical shells and spherical caps. Sixty-two models were machined with local thin spots and flat spots and subjected to external hydrostatic pressure. The analysis is in good agreement with experimental results despite the severity of imperfections selected to test the analysis. The limitations of the analysis are discussed and curves showing the relationship between out of roundness and local radius are presented to aid the design engineer in establishing acceptable tolerance limits for fabrication of spherical shells. Author

N65-22892# Aeronautical Research Labs., Melbourne (Australia).
THE FATIGUE OF 24S-T ALUMINIUM ALLOY WINGS UNDER ASYMMETRIC SPECTRUM LOADING
G. S. Jost Feb. 1964 52 p refs
(ARL/SM-295)

An investigation was made into the fatigue behavior of Mustang 24S-T wings subjected to a random, asymmetric loading spectrum representative of the flight load history of a fighter aircraft. A general description of the experimental apparatus is given. Statistical comparisons show that there are significant differences between the experimental fatigue lives and initial crack propagation rates and those predicted according to four different hypotheses. Author

N65-22918# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
IMPACT STUDIES ON ABLATION-RESISTANT COMPOSITES
G. A. Schmidt, D. G. Flom, T. F. Geib, J. C. Fries, and F. A. Lucy Feb. 1965 43 p refs
(Contract AF 04(694)-486)
(R65SD3; AD-612049)

The evaluation of composite configurations by the flying target technique is discussed. The critical impact pressure for epoxy-neoprene foam rubber–aluminum composite was found to be 2.6 kb. The critical impact pressure for pyrolytic graphite (surface nucleated) neoprene foam rubber–aluminum composite was also found to be in the range of 2.6 kb. It was established that the substrates have a large influence on the critical impact pressure of the composites. Author

N65-22935# Proteus, Inc., Whippany, N. J.
PROPERTIES OF BUOYANT MATERIALS AND STRUCTURES Final Report
J. Irgon, C. Juhasz, D. Z. Lippmann, M. Armstrong, and M. P. Stoltenberg 15 Aug. 1964 137 p refs
(Contract Nonr-4271(00))
(AD-609821)

Information on the various kinds of materials which can be employed for the construction of floating devices is presented. Typical float structures comprised of the materials listed are given, and generalized mathematical relations for calculating the buoyancy and related parameters of a structure in any form and combination of materials are discussed. Data for the density, mechanical strength properties when subjected to the ocean environment, stability characteristics under the conditions of storage and use, compressibility, and thermal expansion coefficient are given for buoyant liquids; buoyant solids; pressurized gases; buoyant cellular materials; materials for rigid shell floats; protective coatings for float structures; typical float structures; and basic formulas. Availability, cost, reliability, and fabrication limitations were also considered. G.G.

N65-22945# Hexcel Products, Inc., Berkeley, Calif.
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE Monthly Progress Report, Aug. 1964
E. C. Vicars 24 Sep. 1964 21 p
(Contract DA-04-200-AMC-477(A))
(MPR-8; AD-609868)

Physical work included design modifications on four cases, and hydrostatic pressure and drop tests for most of them. Case HXL-8-477 was tested as follows: (1) temperature shock test; (2) vibration test; (3) drop test (one end drop, one flat drop); (4) hydrostatic pressure test at 22 psi; and (5) drop tests. Summaries of the tests are presented in tables. G.G.

N65-22948# David Taylor Model Basin, Washington, D. C. Acoustics and Vibration Lab.
SHIPBOARD VIBRATION RESEARCH IN THE U.S.A.
Edward F. Noonan Dec. 1964 81 p refs Presented at 2nd Intern. Ship Struct. Congr., Delft, Netherlands, Jul 1964
(DTMB-1891; AD-611004)

A brief review of the hull vibration program is given. A bibliography of selected reports and papers on ship and machinery vibration is included. A code for shipboard hull vibration measurements is presented. This code is used in the evaluation of commercial type ships. Author

N65-23001*# Southwest Research Inst., San Antonio, Tex.
NONSYMMETRIC TRANSVERSE VIBRATIONS OF TRUNCATED CONICAL SHELLS Technical Report No. 3
U. S. Lindholm and W. C. L. Hu 31 Mar. 1965 57 p refs
(Contract NASr-94(06); SwRI Proj. 02-1504)
(NASA-CR-62573) CFSTI: HC $3.00/MF $0.50

A theoretical and experimental study is presented of resonant frequencies and associated mode shapes of truncated conical shells over a wide range of geometrical and modal parameters. The theoretical analysis incorporates the effects of bending and membrane rigidity, and of inertia terms due to transverse motion as well as meridional and circumferential inplane motion. The experimental results were obtained for four conical shell models, with semivertex angle 14°, 30°, 45°, and 60°. The correlation of both resonant frequencies and mode shapes is very good. Author

N65-23023# Atomics International, Canoga Park, Calif.
FATIGUE CHARACTERISTICS OF 37-TUBE, MODULAR, STEAM GENERATOR HEAD
M. M. Lemcoe 20 Apr. 1965 17 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9827) CFSTI: $1.00

The results of a series of fatigue tests relating to the evaporator and superheater 37-tube module heads for the sodium-heated steam generator are presented. Although the heads tested were fabricated from forged material different from the materials used in the prototypes, it is believed that the information compiled still demonstrates the structural adequacy, with respect to fatigue, of the design and the parent materials used in the prototype steam generator heads. Author

N65-23079# Columbia Univ., New York. Inst. for the Study of Fatigue and Reliability
SECOND ORDER EFFECTS IN DISSIPATIVE SOLIDS
Maria Ronay and A. M. Freudenthal Jan. 1965 95 p refs
(Contract Nonr-266(91))
(TR-13; AD-612078)

A synopsis on theories of second-order effects based on nonlinearity of the strain-displacement equations, or nonlinearity of the constitutive tensor relations, or on a combination of both is presented. The validity of the constitutive equations developed for solid, generally elastic media was investigated for application to nonlinear media. The interaction of a second-order extension with axial load was investigated theoretically and compared with experiments on round bars of high-purity aluminum subject to constant tensile stresses. It was concluded that phenomena of observed so-called instability, developing in cylindrical test specimens subject to cyclic plastic straining, result from an accumulation of permanent second-order strain. G.G.

N65-23122# RAND Corp., Santa Monica, Calif.
DESIGNING TO PREVENT FATIGUE FAILURES
Lloyd Kaechele Feb. 1965 25 p refs Presented at the ASME Design Eng. Conf., New York, 18 May 1965
(AD-611267)

There are three main problem areas in preventing fatigue failures: prediction of the fluctuating stresses that cause fatigue, behavior of the structural material undergoing these stresses, and scatter in stresses encountered in service and in fatigue behavior. The data most important for design, and some techniques for using these data, are presented and discussed. The designer's role in selecting the fatigue problems that should be studied is emphasized. Author

N65-23151# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
THEORETICAL HYPERVELOCITY IMPACT CALCULATIONS USING THE PICWICK CODE First Interim Report
T. D. Riney Feb. 1964 85 p refs
(Contract AF 04(635)-3781)
(R64SD13; AD-430606)

The principle uncertainty in the viscoplastic model of hypervelocity impact is the lack of data on strain-rate effects under the severe conditions of interest. Estimates of μ for iron and aluminum are first determined that are compatible both with observed strain-rate effects in plastic waves and the very abrupt shock profiles known to exist at pressures greater than about 0.2 megabar. Detailed calculations are presented describing the cratering process for a cylindrical projectile impacting a thick target of like metal. It is shown that momentum scaling cannot be justified; energy scaling for geometrically similar impact situations is accurately predicted upon taking into account the different rates of shock propagation during the early stages of the cratering process. The depth of penetration is therefore related to impact velocity v_0 according to $P_c = K_e v_0$ 2/3 for $v_0 \geq v_0^*$. Strength effects of the target do not vanish with increasing impact velocity. The cratering and the penetration process for thin plates is studied. The PICWICK calculations are presented, and the results discussed in terms of the interactions of shock waves, rarefaction waves, and configuration geometry. Author

N65-23200# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
MEMBRANE NATURAL FREQUENCIES FOR SPHERICAL CAPS
Edward W. Ross, Jr. Nov. 1964 17 p refs
(AMRA-TR-64-37; AD-456667)

Natural frequencies and mode shapes are calculated for a spherical cap with its edge fixed. Axially symmetric membrane theory is used. Simple estimates of the natural frequencies are obtained and compared with results for a free edge. Author

N65-23224# Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
OPTIMUM CONSTRUCTION OF REINFORCED PLASTIC CYLINDERS SUBJECTED TO HIGH EXTERNAL PRESSURE Final Report, 6 Mar. 1963–6 Mar. 1964
H. R. Jacobson 6 Mar. 1964 122 p
(Contract NObs-88425)
(SM-45871; AD-433652)

The purpose was to develop and substantiate a theoretical method for accurately predicting the critical buckling strength of externally pressurized cylinders fabricated from filament reinforced plastic (FRP) laminates and to determine the optimum construction for such cylinders. Cylinders representing various configurations of four different types of construction were fabricated and tested. The critical buckling pressure under hydrostatic loading and the elastic constants influential in buckling considerations were determined from the test cylinders and rings cut from them and compared with theoretically calculated values for each configuration. External pressure tests were made on thick-wall versions of two high buckling strength constructions to obtain the biaxial compression strengths of these laminates. Excellent agreement was obtained between theoretical and measured values

of elastic constants. Actual buckling pressures were found to be higher than predicted due to the effect of edge restraints. Laminate compression strengths of 150 000 psi were obtained. Author

N65-23247# Laboratorium für Betriebsfestigkeit, Darmstadt (West Germany).
DESIGN STRESS AND FATIGUE LIFE OF AIRCRAFT STRUCTURAL PARTS OF 1.7704.6 STEEL [BEMESSUNGS-SPANNUNG UND LEBENSDAUER FUR FLUGZEUGBAU-TEILE AUS STAHL 1.7704.6]
W. Schütz [1964] 76 p refs In GERMAN; ENGLISH summary (FB-51; ICAF-301)

The fatigue behavior of 1.7704.6 material is determined by testing notched flat bars with stress-concentration factors between 1.5 and 4.2. Fatigue strength for finite life (constant-stress amplitudes) and program fatigue strength (variable-stress amplitudes) were determined for various stress ratios under axial loads. Tests are designed to permit statistical evaluation. The behavior comparisons are made of two light alloys (2024-T3 and 7075-T6) commonly used in aircraft construction. Results are plotted relative to the design of aircraft structural parts. Author

N65-23249# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
APPLICATION OF VECTOR PLOTTING TECHNIQUES TO FLIGHT FLUTTER TESTING
V. Barsamian Dec. 1964 32 p refs
(ADR-07-06-64.1)

This study is concerned with the development of an automatic data presentation technique directly applicable to real time inflight flutter testing. It is shown that damping can be calculated conveniently and accurately from a plot of the structural response vector to a continuously sweeping sinusoidal force input. The results of numerous applications of the technique to typical structures, both in flight and on the ground, are presented. It is anticipated that the successful automation of the technique presented will not only provide an improvement in the method of determining the system stability, but will also reduce flight test time and the number of personnel required to conduct a flight flutter program with commensurate savings in costs. Author

N65-23269# Pennsylvania State Univ., University Park. Ordnance Research Lab.
FLEXURAL-WAVE-TRANSMISSION PROPERTIES OF PLATE-JOINT AND ROD-JOINT SYSTEMS
D. S. Pallett 31 Mar. 1965 52 p refs
(Contract NOw-65-0123-d-3)
(AD-614264)

The results of a theoretical and experimental study of the flexural-wave-transmission properties of plate joints and rod joints are reported. A discussion of the theory of possible wave-transmitting mechanisms illustrates the complexity of the problem. Finite clamping length is included in a theoretical analysis of the transmission properties of rod joints. Solutions are presented for the transmitted, reflected, and near-field amplitude terms in dimensionless parameters that refer to the physical characteristics of the joint. It is shown that, at low frequencies, joint rotation is the dominant mechanism of transmission; whereas, at the higher frequencies, centroid displacement dominates. Qualitative experimental agreement for this theory is included. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-22230# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
A REPORT GUIDE TO THERMAL TESTING LITERATURE
Charles P. Merhib and Ernest H. Rodgers Aug. 1964 47 p refs
(AMRA-MS-64-14; AD-612043)

This guide consists of a bibliography of items currently in the AMRA nondestructive testing information retrieval system covering the subject of thermal testing. Where available, each item in this journal consists of the following information: (1) item, report, or article title; (2) author or authors; (3) source or facility; (4) report number or identification; (5) date; and (6) abstract. Word descriptors pertinent to each item are listed in alphabetical order and are cross referenced by the AMRA identification number. Also provided is an author index or, if no author is available, the issuing organization is listed. TAB

N65-22305 Aberdeen Proving Ground, Md. Army Ballistic Research Labs.
PREDICTED BLAST PROPERTIES OF PENTOLITE AND THEIR COMPARISON WITH EXPERIMENT
R. E. Shear *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 391-400 refs (See N65-22275 12-34)

It was previously shown that the Brinkley-Kirkwood shock propagation theory adequately predicts the variation of peak incident shock pressure with distance for TNT and Pentolite bursts under sea-level atmospheric conditions. A study to determine if a similar agreement is obtained for bursts in air at reduced pressures is presented. The calculation of the initial shock pressures, resulting from Pentolite explosions in air at 300° K and at ambient pressures of 1, 0.1, and 0.01 atmospheres, provided one of the initial values required for the solution of the differential equations of the Brinkley-Kirkwood propagation theory. The other required initial value is the energy in the hydrodynamic flow field at the termination of the detonation. These initial values were obtained from the detonation calculations previously performed. It was found that the computed pressure-distance curves were in agreement with the experimental observations. The derived pressure-distance curves and the reflected peak pressure computed as a function of incident shock pressure were used to obtain reflected peak pressure as a function of distance. Good agreement with the experimental data was obtained. E.E.B.

N65-22310 Army Missile Command, Huntsville, Ala.
THE MECHANISM OF PREFERENTIAL ABLATION
B. Steverding *In* Army Dept. Army Sci. Conf. Proc., Vol. II [1965] p 453-487 refs (See N65-22275 12-34)

Transpiration and ablation cooling with surface-active agents may decrease the rate of heat transfer substantially. Preferential ablation may be caused by two very different mechanisms: The surface-active agent may be transported to the surface by diffusion, in which case preferential material loss is only possible if the coefficient of diffusion is reasonably large; or the surface-active agent may be transported by

gas bubbles, in which case transport mechanism is independent of viscosity and film thickness. Measuring the preferential ablation rate is useful in determining experimentally whether optimal ablation conditions were reached. Because the addition of a small amount of a surface-active compound will not change the bulk properties of the liquid to any extent, the improvement realized by use of a detergent is strictly additive. This simplifies the problems involved in selection of materials for ablation purposes. Author

N65-22331# Republic Aviation Corp., Farmingdale, N. Y. Re-Entry Simulation Lab.
EXPERIMENTAL STUDY OF THE EFFECT OF AUXILIARY SHOCK GENERATORS ON PRESSURE AND HEAT TRANSFER DISTRIBUTIONS ON A SLIGHTLY BLUNTED TWO-DIMENSIONAL CONCAVE RAMP
John L. Boccio 15 Mar. 1965 69 p refs
(RAC-2838; SMSD-TR-65-3)

An experimental program, studying the effects of externally and locally produced shock-generated vorticity on heat transfer rates and pressure distributions to a slightly blunted two-dimensional ramp, is reported. This program was carried out in the 16-inch Hotshot facility. Mach and Reynolds numbers varied from 18 to 20 and 300 000/ft to 180 000/ft, respectively. The main test body used was slender in cross section, and had a two-dimensional concave surface of constant radius of curvature originating in a blunted wedge. Reduction in pitot pressure and normal vorticity along the model with subsequent reduction in heat rate was effected by an auxiliary body (shock generator) placed upstream of the leading edge of the basic body. The effects of generator position, angle of attack, and free-stream conditions on pressure and heat rate are reported. Schlieren photographs are also included. The effects of local surface protrusions on pressure and heat rate distributions are described. The results were obtained from an abbreviated experimental study. Beneficial aspects of the shock generator concept relative to present and future reentry configurations are discussed. Author

N65-22423# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
EFFECT OF RADIATIVE TRANSFER ON A SOUND WAVE TRAVELING IN A GAS HAVING γ NEAR ONE
F. K. Moore Feb. 1965 45 p refs
(Contract Nonr-2653(00))
(CAL-AF-1285-A-14; AD-613462)

It is shown that the assumption of specific heat ratio near one simplifies the analysis of plane sound waves subject to energy addition dependent on temperature, and in the case of radiative energy exchange in a fairly transparent gas, a third-order differential equation is obtained. Analytical solutions for a hot and a cool gas are presented which give the complete history of velocity and temperature profiles when a wave is produced by an impulsively started piston, with either a black or reflecting face. In a very hot gas, an optically thin wave which is thermally dominated by the piston face (or the undisturbed gas, if the face is perfectly reflecting) disperses as though by relaxation and is followed by an optically thick wave which is thermally independent of the piston and disperses as though by conduction. Transition between thin and thick waves is accomplished in a temperature boundary layer. In a cool gas, dispersion occurs as though by simple radiative heat conduction, dispersion in a transparent gas would be observed on the scale of a meter only if the gas is very hot. Author

N65-22510# Rocketdyne, Canoga Park, Calif.
A ROCKET ENGINE COMBUSTION MODEL FOR THE ANALYTICAL EVALUATION OF UNSTABLE COMBUSTION DAMPING DEVICES Preliminary Report
R. Van Wyk, R. Dickerson, and H. A. Friedman 10 Jan. 1964 46 p refs
(RM-997-351)

A model of the combustion process in a bipropellant liquid rocket engine with a self-impinging doublet injector was formulated, and a numerical method for solving the associated equations was developed. The model is an extension of previous work to include two-dimensional, transient phenomenon, as well as the effects of damping devices on unstable combustion. The numerical method employed is of the predictor–corrector type, and evidence is given for its stability and convergence. Author

N65-22517# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
THERMAL-PHYSICAL PARAMETERS OF MATERIALS Quarterly Progress Report, 21 May–20 Aug. 1964
A. R. Kydd and R. E. Larson 21 Sep. 1964 25 p refs
(Contract DA-19-129-QM-1998)
(QPR-9; AD-457166)

Studies initiated during the previous year of the program involving the utilization of the Mach–Zehnder interferometer to qualitatively and quantitatively investigate fabric degradation processes were continued. Some of the salient features of this optical technique as a means of detecting the presence and amounts of various degradation products released from a cotton fabric during radiation from the arc-image source are discussed. Author

N65-22569# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center
A COMPARISON OF THE FLOW FIELDS ABOUT THE S-II STAGE OF THE SATURN V VEHICLE AND SPIKED HEMISPHERE CONFIGURATIONS WITH EMPHASIS ON THE S-II THRUST CONE HEATING RATES
O. R. Pritts Sep. 1964 31 p refs
(Contract NAS8-11148)
(NASA-CR-62279; LMSC/HREC-A036515; H-64-009)

Flow field resulting from interaction of engine exhaust plumes with external flow field about a vehicle flying at high altitudes is compared to flow field about a spiked hemisphere configuration. Inviscid portions for each configuration are similar; dissimilarities appear in viscous separated flow fields. Conclusions reached are: (1) single engine configurations are somewhat similar to spiked hemispheres when viscous flow fields are compared, because only a small quantity of the gas in separated regions can be attributed to the exhaust plume; and (2) multiengine clusters result in a complex recirculation of exhaust gases the disturb the flow pattern in the separated flow region near the base, causing vast dissimilarities as compared to that found about spiked hemispheres. Chapman's theory is used to determine the magnitude of the S-II stage-Saturn V thrust cone heating rates when external flow is considered without base bleed. These rates vary from 0.03 to 0.086 Btu/ft-sec depending upon plume diameter. Comparison with experimental data obtained for base bleed with no external flow reveal that the external flow field alone can produce heating rates comparable to those produced by exhaust gas recirculation. External flow, therefore, cannot be ignored. Author

N65-22623*# National Aeronautics and Space Administration, Washington, D. C.
THE VIBRATION MECHANISM OF A GASEOUS MIXTURE COMBUSTION [MEKHANIZM VIBRATSIONNOGO REZHIMA GORENIYA GAZOVYKH SMESEY]
S. K. Aslanov and V. V. Kurzhunov Apr. 1965 7 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 8, 1964 p 124–127
(NASA-TT-F-9347) CFSTI: HC $1.00/MF $0.50

Excitation and development of vibrations of gaseous mixture combustion in tubes are considered from the resonance point of view. The theoretical analysis of the problem is the interaction between self-induced vibrations and vibrations due to hydrodynamic instability of the flame front. The possibility of resonant excitation of the system depends on the waves of a definite length present in the system. The experimental data confirm fairly well the adopted point of view. Author

N65-22696# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
HOMOGENEOUS NUCLEATION OF SUPERSATURATED WATER VAPOR IN NOZZLES
Philip G. Hill Jan. 1965 46 p refs
(Contract Nonr-3963(07))
(Rept.-78; AD-611059)

Existing data on the condensation of steam and moist air in supersonic nozzles are compared with predictions based on nucleation and drop growth theory. The effects of uncertainties in cluster surface energy and also of the large corrections to nucleation theory due to the "gasification" concept are examined. It is concluded that if the surface tension is assumed independent of curvature and the classical liquid drop theory (based on a stationary-liquid drop) is used, the theory is in general agreement with the data. The gasification correction is in accord with experimental data only if the surface tension is considered to rise significantly with curvature (as predicted by Oriani and Sundquist and others). In neither case can the Tolman or Kirkwood–Buff equations be supported. A review of existing data shows that there is some question as to the appropriate value of the condensation coefficient but this is of little consequence as long as the accommodation coefficient for the liquid-vapor surface is taken to be unity. Author

N65-22699# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering
THE DESIGN OF RESEARCH APPARATUS FOR CONSTANT-VOLUME COMBUSTION PROCESSES
Everett E. Anderson (M.S. Thesis) 1964 93 p refs
(Contract AF 33(608)-1038)
(AD-611782)

A design for the construction and selection of apparatus for constant-volume combustion processes research is presented. A discussion of the design criteria and calculations with regard to temperature, pressure, material, etc., is made. Complete engineering drawings and material listings are included in order that this paper may be used in the actual construction of a constant-volume spherical bomb and selection of the associated equipment. Author

N65-22830# Oklahoma Univ., Norman. Graduate Coll.
ON THE OSCILLATORY BEHAVIOR OF NATURAL CIRCULATION SYSTEMS
Charles George Lauderdale (M.S. Thesis) 1965 47 p refs
(Contract AF 33(608)-1096)
(AD-612248)

The data observed and recorded lead to the following conclusions regarding the behavior of the natural circulation loop studied: (1) With no cooling flow in the downcomer coils and for a given power input, the larger the restricting orifice in the downcomer the more stable the flow in the loop. (2) With minimum cooling flow—that required to maintain the riser fluid at a p point just below its boiling temperature—and for a given power input, the smaller the restricting orifice the more stable the flow in the loop. (3) For a given power input, the smaller the restricting orifice in the downcomer the larger the difference in temperature between inlet and outlet to the heater. (4) Injecting air in the form of bubble streams at the bottom of the riser has been shown to have a subduing effect on oscillations peculiar to a natural circulation loop, and to allow the fluid to operate in a narrower range of temperatures of inlet and outlet. (5) The luminescent effect observed in the riser immediately before boiling requires a minimum though unknown amount of light incident on the riser tube. The effect was also observed to be pressure dependent. TAB

N65-22916# Los Alamos Scientific Lab., N. Mex.
HIGH THERMAL CONDUCTANCE DEVICES UTILIZING THE BOILING OF LITHIUM OR SILVER
J. E. Deverall and J. E. Kemme 9 Apr. 1965 39 p
(Contract W-7405-ENG-36)
(LA-3211) CFSTI: $2.00

The "Grover Heat Pipe" is a self-contained, thermal conductance device that has no moving parts, utilizes the heat being transferred for its operation, has a thermal conductance higher than any known material, and conducts heat with essentially no temperature difference. Heat is transferred by means of mass flow of a fluid, utilizing the latent heat of a two-phase system. For high-temperature applications, two liquid metals were tested and found suitable as heat pipe fluids: lithium and silver. Lithium heat pipes were successfully operated up to 1300° C with heat input fluxes of 200 W/sq cm and silver heat pipes up to 2000° C with input fluxes of over 400 W/sq cm. Author

N65-22938# Stanford Research Inst., Menlo Park, Calif.
THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS Quarterly Technical Summary Report, 1 Jan.–31 Mar. 1963
George M. Muller 30 Apr. 1963 11 p
(Contract AF 49(638)-565; ARPA Order 317-62)
(Rept.-17; AD-609886)

Instrumentation problems encountered in the continued investigation of the reflected pulse method for measuring the normal acoustic admittance of burning propellant surfaces, are reported. Two major problems encountered with the transducers are: (1) a relatively low signal to noise ratio results from the low sensitivity of the microphone, and (2) the large (1-inch) outside diameter of the microphone flame shield generates excessive turbulence at the point where the flat ended microphone is mounted in the circular tube. Problem (1) was overcome by using somewhat larger pulses in the cold tests. Methods used to obtain suitable pulses are discussed. Problem (2) was solved by building an extension for the flame shield to provide an unbroken continuation of the interior contour of the pulse tube. This extension causes a microphone resonance around 7 or 8 kc/s, making it imperative to eliminate as many of the higher frequencies as possible from the pulse. Stability and synchronization problems inherent in the circuitry for the multiline recording system have been overcome. A new master grid of 120 lines/cm was obtained to improve the accuracy of pulse measurements. Tests indicate that it should yield excellent replicas. S.C.W.

N65-22997# National Aerospace Lab., Tokyo (Japan).
CHARACTERISTICS OF A VORTEX STABILIZED PLASMA GENERATOR
Kenji Inoue and Shigeaki Nomura 1964 38 p refs In JAPANESE; ENGLISH summary
(NAL-TR-67)

The purpose is to determine the performance characteristics of a vortex stabilized plasma generator designed as a heater of a hypersonic wind tunnel. The voltage vs. current characteristics were examined and an energy balance was presented from which the enthalpy increase of gas and energy conversion efficiency were determined. For this generator, the arc current ranged from 100 to 500 A and chamber pressure was adjusted between 1.1 and 2.0 atm, using nozzle throat diameter 3, 5, 7 mm and electrode gap 3, 5, and 7 mm. The maximum enthalpy throughout the experiment was 2086 cal/g using argon as working gas at the flow rate of 0.57 g/sec for 5-mm diameter nozzle and 3-mm electrode gap. The temperature distribution in the plasma column was determined by spectroscopic method and the energy involved in the plasma column was compared with the value obtained from the heat balance. The maximum temperature was 17300° K on the center line of the column at the position 3 mm downward from the nozzle exit. The electron–ion temperature relaxation was discussed to discover whether or not the plasma jet blown out from the generator was in a state of equilibrium. Author

N65-23000*# American Radiator and Standard Sanitary Corp., New Brunswick, N. J. Advanced Technology Labs. Div.
HEAT-FLUX-TRANSDUCER DESIGNS AND EFFECT OF THERMAL DISTURBANCES ON TRANSDUCER PERFORMANCE Final Report, Jun. 1963–Oct. 1964
R. C. Bachmann 26 Oct. 1964 177 p refs
(Contract NAS8-5323)
(NASA-CR-62537; ATL-D-1271) CFSTI: HC $5.00/MF $1.00

An analysis and experimental evaluation of the important parameters affecting the accuracy and application of several slug-type and membrane-type calorimeters was performed, with emphasis on slug-type meters because of their convenience and widespread use. Consideration of purge-gas flow in the evaluation of copper-slug radiometers eliminated data scatter and the dependence on the mounting structure. The presence of a large convective load on the copper-slug radiometer did not change the calibration for purely radiant heating. Heat-flux measurements with a nickel-slug total calorimeter were independent of mounting structure and heating conditions for heating rates below 15 Btu/ft^2-sec. The nickel-slug total calorimeters were found superior to copper units. A total membrane calorimeter mounter in M-31-coated heat-shield panels showed extremely erroneous output. Water absorption by the heat shield material altered the heating rate. No agreement in radiant-heating data was observed between the membrane total calorimeter and the membrane radiometers for a given radiation source temperature. Radiant heating effected the output of a gas-temperature probe. G.G.

N65-23024# Atomics International, Canoga Park, Calif.
INCREASING THERMOCOUPLE RELIABILITY FOR IN-PILE EXPERIMENTS
E. L. Babbe 20 Apr. 1965 43 p ref
(Contract AT(11-1)-GEN-8)
(NAA-SR-10511) CFSTI: $2.00

As temperature and reactor residence time requirements for inpile experiments increase, thermocouple failures have become more numerous. Because thermal cycling conditions cause failure rates to increase, laboratory-produced thermal shock tests were performed. The results indicate that increased reliability can be obtained by using thermocouples made with insulation of increased density and/or a low thermal expansion sheath. Author

N65-23075# National Bureau of Standards, Washington, D. C.
TABLES OF THERMODYNAMIC PROPERTIES OF AIR IN CHEMICAL EQUILIBRIUM INCLUDING SECOND VIRIAL CORRECTIONS FROM 1500°K TO 15000°K
Joseph Hilsenrath and Max Klein Tenn., Arnold Eng. Develop. Center, Mar. 1964 346 p refs Supersedes AEDC-TDR-63-161; See N65-20997
(Orders DO-40(600)59-24; DO-40(600)63-136; DO-40(600)64-195)
(AEDC-TR-65-58; AEDC-TDR-63-161; AD-612301)

Tables for the thermodynamic properties for air are presented which take into account the effect of dissociation and ionization and the limiting-law Debye–Hückel and second virial corrections upon the thermodynamic properties and the equilibrium compositions. Values are tabulated from 1500° K in steps of 100° to 15000° K at close spacings in the logarithm of the density [$\log_{10} \rho/\rho_0 = -7.(0.2)2.2$] for the compressibility factor $Z = PV/RT$; the dimensionless functions for internal energy, E/RT; enthalpy, H/RT; entropy, S/R X_i; $\log_{10}P$ (atm) and $Z^* = \Sigma C_i$. The underlying equations and the input data are discussed briefly. The effects of the real gas corrections on the equilibrium properties are illustrated graphically. The equilibrium composition is given for selected temperatures over the tabulated density range. Author

N65-23080# Hiller Aircraft Corp., Palo Alto, Calif.
INVESTIGATION OF THE PROCESS OF ENERGY TRANSFER FROM AN INTERMITTENT JET TO SECONDARY FLUID IN AN EJECTOR-TYPE THRUST AUGMENTER Interim Summary Report, 30 Oct. 1962–31 Mar. 1964
Raymond M. Lockwood and Harry W. Sander 31 Mar. 1964 101 p refs
(Contract Nonr-3082(00))
(APR-64-4; AD-611137)

Besides application of high-speed temperature measuring instrumentation, a search was made for a digital computer program that could be adapted to the problem. This resulted in the evaluation of the KO code developed by the U. of Cal. Radiation Laboratory. This code uses a numerical differencing method with injection of a 'Q-term' of artificial viscosity whenever an incipient shock condition develops. The addition of the 'Q-term' in appropriate amounts prevents a discontinuity so that the computer program can then handle the shock condition and determine when and where it will develop as well. TAB

N65-23099# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DEPENDENCE BETWEEN THE VALUE OF THE HEAT PRODUCTION COEFFICIENT AND THE LOWER HEAT OF FUEL COMBUSTION
I. Ye. Bespolov, A. V. Guseva, and O. I. Timonicheva 5 Feb. 1965 8 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 4, 1963 p 64–65
(FTD-TT-64-936/1+2; AD-611529)

Linear relationship between the heat production coefficient and the lower heat of fuel combustion was observed in experiments with various reactive fuels. The heat production coefficient is defined as the product of fuel density and the aniline temperature point. The test data were plotted with lower heat of reactive fuel combustion on the ordinate and the corresponding heat production coefficient on the abscissa; coefficient values ranged from 4500 to 7200, and

the heat capacity values extended from 10215 to 10382 kcal/kg. The graph shows a good linear relationship between the variables. Constants calculated from the data produced a linear regression equation which can be used as a simple means of determining heat of combustion for materials in production processes. The equation is $Q_H = 9939 + (0.0615)$ K, where K is the computed heat production coefficient and Q_H is the heat of combustion value determined in units of kcal/kg. J.M.D.

N65-23130# General Applied Science Labs., Inc., Westbury, N. Y.
THEORETICAL PERFORMANCE WITH EXTERNAL BURNING ON SURFACE
A. Marino Feb. 1965 134 p refs
(ARPA Order 460; Proj. Defender)
(GASL-TR-506; AD-611772)

A theoretical analysis and calculated results of external burning on a plate, applicable also to practical cases of burning on a cone, are presented. Two constant-pressure-burning cases were studied: (1) two-dimensional, in which the burning region assumes the shape of a wedge and the pressure rise is confined to the surface on which burning takes place; and (2) conical, in which the burning region shape is the frustrum of a cone and the pressure rises extend beyond the burning surface. The basic results are given for Mach numbers from 2 to 20 in a form which shows the fuel economy, essentially the variation of specific force (force per unit fuel flow) with fuel flow density (fuel flow per unit surface). A major conclusion is that with burning on equal surfaces, two-dimensional burning produces a greater specific force than conical burning. Author

N65-23141# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DECAY OF ELECTRON DENSITY IN THE WAKES OF HYPERVELOCITY SPHERES
W. M. Kornegay 23 Dec. 1964 20 p refs
(Contract AF 19(628)-500; ARPA Order 600)
(TR-370; ESD-TDR-64-592; AD-612152)

The electron line density in the wakes of hypervelocity aluminum and copper spheres traveling 18000 to 21000 feet per second was measured as a function of time, by means of a transmission resonant cavity. The ambient pressure was varied over the range of 10 to 160 torrs to determine its influence on the electron density decay. Typical results are given for measurements of the electron density in air and in nitrogen. A significant electron density was found to persist in nitrogen trails for long times, because the electron–ion recombination reaction is the only important electron removal process. In air, electron attachment becomes the predominant process for electron decay, after an initial period when electron–ion recombination controls the decay. Results on the effect of ablated aluminum and sabot material on the electron density decay are given. Electron decay data which can be repeated from shot to shot, without large discrepancies, are shown to be obtainable under carefully controlled experimental conditions. Author

N65-23159*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTAL AND ANALYTICAL STUDIES OF CRYOGENIC PROPELLANT TANK PRESSURANT REQUIREMENTS
M. E. Nein and J. F. Thompson 25 Feb. 1965 109 p refs
(NASA-TM-X-53165) CFSTI: HC $4.00/MF $0.75

Results of experimental and analytical studies of pressurization gas requirements for cryogenic liquids are presented. Methods of analysis are reviewed and compared with experimental data for cylindrical and spheroidal tanks. Physical parameters and constants for an analytical model are determined on the basis of experimental results. Author

N65-23162*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TECHNIQUE FOR MEASURING HIGH-TEMPERATURE ISOTHERM PATTERNS ON AERODYNAMICALLY HEATED MODELS WITH EXPERIMENTAL RESULTS
Irving Weinstein and Robert R. Howell Washington, NASA, May 1965 48 p refs
(NASA-TN-D-2769) CFSTI: HC $2.00/MF $0.50

The accuracy and detail to which temperatures and variations in temperature over the surface of aerodynamically heated ceramic models of hypersonic vehicles can be measured with a photographic pyrometer were investigated. Models were of a ceramic which could withstand test temperatures without melting, and reach surface equilibrium temperatures within the test period. Tests were in a medium of methane–air combustion products at nominal Mach 7.0, at total temperatures from approximately 2700° F (1756° K) to 3180° F (2022° K), and at model stagnation-point pressures from 5 to 17 psia (34 to 117 kN/m^2). The corresponding range of free-stream Reynolds numbers varied from 0.44×10^6 to 1.58×10^6 per foot (1.44 to 5.19 per μm). Results indicate that the technique can determine surface temperatures and nondimensional heating-rate ratios with reasonable accuracy. This technique provides ready definition of the areas of increased heating on the surface resulting from surface irregularities or component interference. Isotherm patterns presented over the surfaces of several configurations show the detail to which variations in surface heating can be detected. Author

N65-23204# RAND Corp., Santa Monica, Calif.
EFFECT OF VOLUMETRIC ABSORPTION COEFFICIENT ON ROSSELAND RADIATIVE HEAT TRANSFER
R. L. Spicer Jan. 1965 20 p refs
(P-3061; AD-612288)

Calculating the temperature profile and heat transfer associated with an optically dense fluid, it was the practice to use Rosseland's approximation for the radiative heat flux. However, little is known about the form of the absorption coefficient which is the fluid-characteristic term in the approximation. It is revealed in this analysis that in the case of uniform fluid (optically dense) flow past a flat plate, the calculated temperature profiles and heat transfer to the wall by radiation alone are very sensitive to the choice of the form of the absorption coefficient. Author

N65-23223# Auburn Research Foundation, Inc., Ala.
METHODS FOR COMPUTING THERMAL CONDUCTIVITY, THERMAL DIFFUSIVITY, AND SPECIFIC HEAT Progress Report, Mar.–Jun. 1964
G. E. Tanger, G. H. Nix, S. C. Cheng, and G. W. Lowery Jul. 1964 60 p refs
(Contract DA-01-009-ORD-1023)
(PR-IX; AD-457935)

The study of thermal property determination has continued; and the properties investigated include thermal diffusivity, thermal conductivity, and specific heat. The methods developed will be used to determine accurate thermal properties for the Pershing missile system and for other propellants. The method for determining thermal diffusivity has been refined, and new tests point out obtained improvements in accuracy. Limitations of the experiment are discussed. Several

improvements were made in the line-source method for determining thermal conductivity. The improvements are designed to make the method competitive with the guarded hot-plate method. Test results on live sargeant and aluminum staple propellant are reported. A calorimeter for determining specific heat was developed and will be used to support other property measurements. The calorimeter is based on the standard ASTM procedure for determining specific heat of insulating materials. Silicone rubber was used as a standard, and results of tests performed are presented. A design of the wind tunnel was completed, and is discussed. A test cylinder was designed for simulating a missile surface under varying environmental conditions. Author

N65-23238# Los Alamos Scientific Lab., N. Mex.
SATELLITE HEAT PIPE
J. E. Deverall and J. E. Kemme 20 Apr. 1965 23 p refs
(Contract W-7405-ENG-36)
(LA-3278-MS) CFSTI: $2.00

A heat pipe was developed which will be used in a satellite to transfer heat isothermally from an externally mounted radioisotope to the electronic component section. The purpose of this system is to reduce the amplitude of temperature cycling of the components when in orbit. The heat pipe is stainless steel with water as the working fluid. Heat from the isotope capsule is transferred to the pipe through an aluminum block assembly. Stainless steel clamps hold the capsule in position and supply the necessary pressure for good thermal contact. This arrangement provides for simple removal of the isotope for shipping. Several test models were built and tested using electric heaters to simulate the isotope heating. A satisfactory design was developed which will transfer more than 90% of the isotope heat to the required zone. Author

N65-23240# Los Alamos Scientific Lab., N. Mex.
THE TWO-DIMENSIONAL HYDRODYNAMIC HOT SPOT, VOLUME II
Charles L. Mader 3 Apr. 1965 126 p refs
(Contract W-7405-ENG-36)
(LA-3235, Vol. II) CFSTI: $4.00

The basic processes in the shock initiation of inhomogeneous explosives are investigated theoretically using the model of a cylinder of nitromethane containing either a cylindrical or a biconical void, or a sphere or cylinder of aluminum. The interaction of a shock with these density discontinuities, the resulting formation of a hot spot, and the buildup to propagating detonation are computed using two-dimensional numerical hydrodynamics of the PIC type. For the aluminum density discontinuities, the calculations exhibit failure or propagation of detonation from the hot spot in approximately the same manner as does the one-dimensional hydrodynamic hot spot model. The interaction of a shock with corners of aluminum and Plexiglas in nitromethane is discussed. Radiographs of a shock interacting with a spherical bubble in water, compared with theoretical calculations, confirm the validity of the computations. Author

N65-23286*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TURBULENT BOUNDARY-LAYER HEAT TRANSFER FROM RAPIDLY ACCELERATING FLOW OF ROCKET COMBUSTION GASES AND OF HEATED AIR
D. R. Bartz Dec. 1963 128 p refs
(Contracts NASw-6; NAS7-100; DA-04-495-ORD-18)
(NASA-CR-62615) CFSTI: HC $4.00/MF $1.00

The complexity of the problems associated with prediction of the heat transfer from the combustion gases to the walls of both the combustion chamber and the nozzle is discussed, and a pragmatic approach based on a number of plausible assumptions is proposed. The plausible assumptions with their restrictions and the methods of using them in predictions of boundary-layer development and heat transfer are discussed. To establish the validity of these methods, the predictions are compared with the results of carefully controlled experiments in which the existence of the assumed restricted conditions is assured. The predictions are also compared with measurements of real rocket thrust chamber flows under a wide variety of conditions to determine to what extent the real flows deviate from those assumed in the model. M.P.G.

N65-23299# Space Technology Labs., Inc., Redondo Beach, Calif.
HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF A 15% CO_2–85% N_2 MIXTURE
J. T. Ohrenberger 5 Mar. 1964 12 p ref
(STL-9990-6631-TU-000)

Thermodynamic properties of a 15% CO_2–85% N_2 (by volume) mixture to 10000° K in the pressure range from 10^{-5} to 10 atm, calculated using a modified equilibrium chemistry program, are presented. The composition chosen simulates a model planetary atmosphere, and the data presented are applicable to entry vehicle radiant heating and communications blackout analyses. Curves presenting the following information are given: (1) the relation between enthalpy and pressure along lines of constant temperature, constant enthalpy, and constant Z (molecular weight of original mixture divided by molecular weight of reacted mixture); (2) the relation between the mole fraction of CN, CO, CO^+, and temperature along lines of constant pressure; and (3) the relation between the electron concentration and temperature along lines of constant pressure. Equations of state, mass fraction conversions, and expressions for finding the number of particles per unit volume are also given. M.P.G.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-22224# General Dynamics/Astronautics, San Diego, Calif.
INVESTIGATION FOR AN IMPROVED TECHNIQUE FOR THE ASSESSMENT OF MATERIALS REQUIREMENTS OF FUTURE WEAPONS SYSTEMS. PART I: DEVELOPMENT OF ANALYTICAL TECHNIQUES
W. H. Steurer and F. F. W. Krohn Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 290 p refs
(Contract AF 33(657)-8925)
(GDA63-1214; ML-TDR-64-94, Pt. I; AD-611172)

This report delineates the development of an improved analytical method for the determination of systems performance gains resulting from materials improvements. The development was initiated by means of detailed experimental systems analyses of an aerospace-plane-type vehicle and a supersonic transport. This report describes the development of the analytical technique and its individual procedures, supplemented by pertinent support materials and information. Author

N65-22275# Army Dept., Washington, D. C.
ARMY SCIENCE CONFERENCE PROCEEDINGS. VOLUME II: PRINCIPAL AUTHORS I THROUGH Z

[1965] 535 p refs Conf. held at U.S. Military Acad., West Point, N. Y., 17–19 Jun. 1964
(AD-611869)

Scientific papers presented at the 1964 Army Science Conference arranged for the principal authors, I through Z. For individual titles see N65-22276–N65-22314.

N65-22315# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Jan. 1965 44 p refs
(AD-612611) CFSTI: $1.25

CONTENTS:

1. A METHOD FOR EVALUATING TRANSDUCER LOADING EFFECTS ON ULTRASONIC TRANSIT TIME MEASUREMENTS E. W. Kammer p 1–5 refs (See N65-22316 12-23)

2. SURVEY FOR RADIOACTIVE CONTAMINATION IN THE VICINITY OF THE USS THRESHER C. F. Dohne and J. I. Hoover p 6–13 refs (See N65-22317 12-13)

3. SCIENTIFIC PROGRAM p 14–42 refs

N65-22379# National Opinion Research Center, New York.
COMMUNITY REACTIONS TO SONIC BOOMS IN THE OKLAHOMA CITY AREA Research Report No. 101, Apr. 1963–Feb. 1965
Paul N. Borsky Feb. 1965 59 p
(Contract AF 33(657)-11148)
(AMRL-TR-65-37; AD-613620)

The Oklahoma City, Oklahoma, area was repeatedly exposed to sonic booms generated by a simulated schedule of supersonic transport overflights during a period of 6 months from February to July 1964. The schedule provided for eight sonic booms per day programed at an intensity of 1.5 pounds per square foot (psf) during the first portion of the study and 2.0 psf during the latter stages. Almost 3000 local residents were personally interviewed three times during the 6-month period to determine the nature and extent of their reactions to the sonic booms. Among the findings it was shown that substantial numbers of residents reported interruptions of ordinary living activities, and some annoyance with these interruptions. However, the overwhelming majority felt they could learn to live with the numbers and kinds of booms experienced during the 6-month study. Author

N65-22645# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 170
14 Apr. 1965 82 p refs Transl. into ENGLISH from Chinese Periodicals
(JPRS-29597; TT-65-30740) CFSTI: $3.00

CONTENTS:

1. SPONSOR WORKER CLASSES AND TRAIN MORE SCIENTIFIC AND TECHNOLOGICAL TALENTS OF THE NEW TYPE p 1–12

2. NON-LINEAR STABILITY PROBLEM OF ROUND BOTTOM THIN SPHERICAL SHELLS. I: THE NON-LINEAR STABILITY PROBLEM OF A ROUND BOTTOM THIN SPHERICAL SHELL UNDER A SYMMETRICAL LINEAR LOAD K'ai-yuan Yeh, Jen-huai Liu, Ch'ing-yuan P'ing, and Szu-lai p 13–20 refs (See N65-22646 12-32)

3. NON-LINEAR STABILITY PROBLEM OF ROUND BOTTOM THIN SPHERICAL SHELLS. II: THE NON-LINEAR STABILITY PROBLEM OF A ROUND BOTTOM THIN SPHERICAL SHELL UNDER EDGE TORQUE K'ai-yuan Yeh, Jen-huai Liu, Ch'uan-chih Chang, and I-fan Hsu p 21–26 refs (See N65-22647 12-32)

4. RECENT DEVELOPMENT IN CHINA OF IRRIGATION USING CITY WASTE WATER Tsu-yuan Kuo, P'ei-yuan Yang, and Te-chin Wang p 27–46 refs

5. CHROMATOGRAPHIC QUANTITATIVE ANALYSIS BY HYDROGEN IONIZATION DETECTOR T'ai'ch'ien Li and Shao-i P'eng p 47–54 refs (See N65-22648 12-06)

6. EFFICIENCY ADSORPTION COLUMN ANALYSIS OF GASEOUS HYDROCARBONS Li-chih Hu and Shao-i P'eng p 55–60 refs (See N65-22649 12-06)

7. RECENT STUDY OF FOREIGN LIGHT IRRADIATION TECHNIQUE Wu-han Huang p 61

8. CRYSTALLINE STRUCTURE OF THE HYDRATE OF L-PROLINE-GLYCINE Cheng-chiung Lin, Chia-huai Wang, and Hai-fu Fan p 62–68 refs

9. RUNOFF FORECAST OF STORMS OVER LOESS: PRELIMINARY EXPERIMENTAL STUDY Ch'ang-ming Liu, Pao-hsin Hung, Ming-hsuan Tseng, and Ch'eng-i p 69–75 refs

10. CHINA PROGRESSES IN FIGHT AGAINST CANCER p 76–78

N65-22693# RAND Corp., Santa Monica, Calif.
ESTABLISHING OBJECTIVES, MEASURES, AND CRITERIA FOR MULTI-PHASE COMPLEMENTARY ACTIVITIES
Sidney I. Firstman and David S. Stoller Jan. 1965 27 p refs
(P-3062; AD-611568)

The process of getting a rocket through countdown and launch is described as a time-phased sequence of complementary activities, and the establishment of quantitative decision rules countdown, and finally the commitment to launch; within each phase numerous operations are defined. Each task has a distinct objective. To complete the description of such a model the desired states of each activity, quantitative representation objective. To complete the description of such a model the desired states of each activity, quantitative representation of the various possible states, and numerical values corresponding to the states, must be established. Probability measures or expected values are chosen for the separate states, and ranges of values are assigned meanings with respect to system performance at the separate stages. Problems in determining compatible measures are discussed. J.M.D.

N65-22732# Army Dept., Washington, D. C.
ARMY SCIENCE CONFERENCE PROCEEDINGS. VOLUME I: PRINCIPAL AUTHORS A THROUGH H
[1964] 526 p refs Conf. held at U.S. Military Acad., West Point, N. Y., 17–19 Jun. 1964
(AD-611432)

Papers given at the Army Science Conference are presented arranged by principal authors A through H. For individual titles see N65-22733–N65-22765.

N65-22764 Army Tank-Automotive Command, Center Line, Mich.
FRICTION HYDRO PNEUMATIC SUSPENSION SYSTEM
William J. Hart, Jr., Robert J. Otto, and Alex H. Sinclair *In* Army Dept. Army Sci. Conf. Proc., Vol. I [1964] p 441–468 refs (See N65-22732 12-34)

Suspension systems were investigated to more clearly define the dynamic relationships between a vehicle and the terrain over which it must travel, and to establish parameters

which can be applied directly to vehicle design for improvement in vehicle cross-country mobility. It was concluded: (1) A suspension system can be designed to provide a 41-ton tank with approximately 100% increase in cross-country speed without increasing the power-to-weight ratio of the vehicle. (2) A suspension system with a low spring rate and adequate damping can provide a significant reduction in pitch and bounce vibrations, thereby increasing vehicle cross-country speed without degrading crew effectiveness or the vehicle weapons system. (3) The design of cross-country vehicles with a speed of 30 to 35 mph is feasible within the present state of the art. E.E.B.

N65-22852# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 169
13 Apr. 1965 45 p Transl. into ENGLISH from Chinese Periodicals
(JPRS-29594; TT-65-30721) CFSTI: $2.00

CONTENTS:
1. THE ANALYSIS OF POLYVINYL ALCOHOL ON TEST PAPER Ch'en Kang p 1–7 refs
2. NEW DEVELOPMENTS IN PLANETARY ROLLING MILLS Hu Hsing p 8–13 (See N65-22853 12-15)
3. SEVERAL STRAINS OF WINTER WHEAT Mei-sen Li p 14–17
4. THE PREVENTION OF THE BLACK-TASSEL PEST IN WHEAT, BARLEY, RYE AND OAT p 18–19
5. THE PREVENTION OF PROPAGATION AND DAMAGES CAUSED BY NEMATODA AND POISONOUS WHEAT T'ien Ting p 20–21
6. GOOD STRAINS OF WINTER WHEAT WITH RUST-PEST RESISTANCE AND RUST-PEST ENDURANCE Ho Chia p 22
7. PRODUCTION AND APPLICATION OF POWDER METALLURGY MACHINE PARTS IN CHINA Wen-chih Chung p 23–36 ref (See N65-22854 12-15)
8. CHANGES TAKE PLACE IN DESIGHING WORK p 37–42

N65-23020# Stanford Research Inst., Menlo Park, Calif.
AN ECONOMIC ANALYSIS OF COMMERICAL VTOL AND STOL TRANSPORT AIRCRAFT Final Report
Richard K. Waldo and Peter D. Tilton Feb. 1965 234 p refs
(Contract FA-64-WA-4997)
(FAA-ADS-25)

A preliminary market analysis on the VTOL and STOL transport aircraft is presented, together with a current assessment of the state of the art. The most critical deficiency will be in the direct operating costs which will preclude competition over stage lengths of more than 300 miles. The noise levels for a feasible V/STOL aircraft will be only marginally acceptable, and the area required for takeoff and landing makes VTOL more suitable for city-center service. It is concluded that commerical V/STOL development would be attractive only as a follow-on to a military program. G.G.

N65-23146# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 177: COHERENT INTEGRATING FILTER FOR PULSE RADAR APPLICATIONS
5 May 1965 17 p refs Transl. into ENGLISH from Tien-Tzu Hsueh-Pao (Peiping), no. 2, Dec. 1963 p 3–11
(JPRS-29951; TT-65-30927) CFSTI: $2.00

A practical means is presented for the design of a Coherent Integrating Filter, CIF, which covers the whole Doppler frequency range with a single channel. It is much simpler than the usual way of implementing coherent integration by a large number of parallel channels, each matched at a different Doppler frequency. This method is superior to the parallel matched filter scheme. This paper analyzed the principle of operation of CIF, and pointed out how to get the best signal-to-noise ratio for pulse train high frequency signals when an integrating filter, made from this kind of integrator, is used. It also has pointed out the property of such integrating filters by using the idea of uncertainty function, the superiority of such filters to pulse train matched filters, and the larger possibility of realization of the former. A block diagram of a radar system with CIF is presented, and the choice of some system parameters explained. Author

N65-23229# Congress. Senate. Committee on Aeronautical and Space Sciences.
SPACE LAUNCH VEHICLES
Washington, GPO, 1965 140 p refs Hearings before Comm. on Aeron. and Space Sci., 89th Congr., 1st Sess., 26–27 Jan. 1965

N65-23231# United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
INTRODUCTION TO CRITICAL PATH PLANNING
G. T. Sneddon Sep. 1963 34 p
(AERE-M-1280)

This paper describes techniques to produce a network showing the activities relating to any particular project, the emphasis being upon the practical problems encountered in preparing the network to suit the facts of the case. A simplified example is used to demonstrate the pitfalls and the method of analysis. Author

N65-23310# Congress. House. Committee on Appropriations.
INDEPENDENT OFFICES APPROPRIATIONS FOR 1966
Washington, GPO, 1965 1278 p Hearings before Subcomm. of the Comm. on Appropriations, 89th Congr., 1st Session

N65-23342# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1966. PART I: SCIENTIFIC AND TECHNICAL PROGRAMS AND PROGRAM MANAGEMENT
Washington, GPO, 1965 660 p Hearings before Comm. on Aeron. and Space Sci. on S. 927, 89th Congr., 1st Sess., 8–12, 15 Mar. 1965 GPO: $2.25

N65-23343# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1966. PART 2: PROGRAM BUDGET DETAIL
Washington, GPO, 1965 419 p Hearings before Comm. on Aeron. and Space Sci. on S. 927, 89th Congr., 1st Sess., 22–25, 30 Mar. 1965 GPO: $1.25

N65-23344# Congress. Senate. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1966. PART 3. POST APOLLO PLANNING DOCUMENTS AND INFORMATION RELATING TO THE FISCAL YEAR 1965 AUTHORIZATION
Washington, GPO, 1965 117 p Hearings before Comm. on Aeron. and Space Sci. on S. 927, 89th Congr., 1st Sess.
GPO: $0.40

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